CTSW-RT-01-038

FINAL REPORT
CALTRANS TAHOE BASIN STORMWATER MONITORING PROGRAM

MONITORING SEASON 2000-2001

AUGUST 2001

Prepared for:

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Section 1
Introduction

1.1 Background

This report presents results and data evaluations of the Tahoe Basin Stormwater Monitoring Program conducted for the California Department of Transportation (Caltrans). The stormwater runoff monitoring was performed in the southern portion of the Lake Tahoe Basin during the period of July 2000 to April 2001.

Caltrans stormwater monitoring projects are designed to provide data to support the Caltrans stormwater management program and to comply with various regulatory and legal requirements. The Tahoe program is part of a statewide study designed to provide data needed in high elevation areas to supplement the existing database that characterizes runoff from various Caltrans facilities (Caltrans 2001)

In addition, the Tahoe Basin Stormwater Monitoring Program was initiated in response to the environmental concerns in the Basin regarding decreasing water clarity of Lake Tahoe, poor forest health, impacted air quality, and increased population growth. A number of government agencies (Federal, state, and local), and business and environmental entities have been working together to address these concerns.

Caltrans maintains over 68 miles of roadways in the Tahoe Basin as well as several maintenance and material storage yards (District 3 Caltrans, October 2000). The contributions of the stormwater runoff and snow management activities from these facilities need to be established to assist with the overall management of Lake Tahoe and the surrounding watershed.

1.2 Project Overview and Objectives

This first year of the Tahoe Basin Monitoring Program focused on the development and testing of field methods for high elevation and cold weather monitoring and basic data gathering. Results of the first year monitoring will be used to refine study objectives and monitoring methods to be applied in subsequent seasons in the Lake Tahoe Basin and, possibly, other locations or monitoring programs. The specific objectives of the first year of the Tahoe Program were as follows.

1.2.1 Runoff Water Quality

Collect data to preliminarily characterize runoff from urban and rural highways, based on the following assumptions:

- There are two distinct types of roadway and right-of-way conditions in the basin: urban and rural.
- Rural roadway segments have lower average daily traffic (ADT) volumes than urban segments.

Collect data to preliminarily characterize highway runoff during snow management operations at both lake-level and mountain pass elevations, based on the following assumption:

- Snow management operates under two modes, high elevation and lake-level elevations.

Collect data to preliminarily characterize seasonal differences in highway runoff, based on the following assumption:

- There are three different runoff conditions in the Tahoe Basin represented by: summer thunderstorms; winter/spring snow melt; and transitional with snow/rain mix (fall and spring).

1.2.2 Precipitation (Rain and Snowfall) Water Quality

Collect samples to preliminarily characterize precipitation water quality. The characterization will include the variability of rainwater quality amongst different locations in the southern Tahoe Basin and the relative contributions of precipitation loads to observed constituent concentrations in Tahoe area highway runoff.

1.2.3 Sediment Size Distribution and Quality

Collect data to preliminarily identify and characterize sediment found in highway runoff and other pollutants of concern associated with the sediment. In addition, perform a preliminary evaluation of:

- The sediment capture characteristics of the double barrel sand traps employed by Caltrans in the Tahoe Basin to control sediment in the runoff; and

- Storm water sediments collected by current automatic sampling methods and the representativeness of the samples to characterize the total sediment loading.

1.3 Report Organization

This report is organized as follows:

- Section 2 describes the monitoring locations and the site characteristics.

- Section 3 summarizes the sampling and monitoring methods used in this study for water quality, precipitation, sediments, and autosampler representativeness.

- Section 4 presents the results of the field data collected during this study for precipitation, flow, water quality, and precipitation quality.

- Section 5 presents the field data on sediment size distributions and sediment quality.

- Section 6 summarizes the evaluation of the data from water quality monitoring, sediment monitoring, and autosampler representativeness.
- Section 7 summarizes the major findings and recommendations for future monitoring programs in the Tahoe Basin.
- Section 8 lists the references cited within the text.
- Section 9 is a glossary defining specific terms and acronyms used in the text.

Appendices A through F contain additional detailed information regarding the study.

Section 2
Monitoring Locations

2.1 Site Selection

Based on the study goals and objectives discussed in Section 1, three highway runoff categories were selected to represent roadways in the Tahoe Basin. These categories include:

- Rural (low ADT) at lake-level elevation,
- Urban (high ADT) at lake-level elevation, and
- Rural (low ADT) at high elevation (mountain pass)

No high elevation roadways with urban development or high ADT were located in the Tahoe Basin.

Representative monitoring locations were selected for each of the three Caltrans roadway categories. The selection process and results are documented in the internal Caltrans memorandum entitled, *Tahoe Basin Monitoring Site Recommendations* (June 9, 2000).

The site selection process presented in Section 3 of the Caltrans *Guidance Manual: Stormwater Monitoring Protocols (Revised May 2000)* was applied to ensure selection of the most appropriate monitoring locations. Additional selection criteria specific to the Tahoe Basin study included:

- The source of the runoff would be from Caltrans roadways only.
- Opportunity for treatment of the runoff after sampling but prior to entering Lake Tahoe or any of its major tributaries. District 3 has requested sampling be performed at locations where it can be demonstrated that the runoff receives treatment after sampling, such as being directed through sediment traps, grassy swales or wetland treatment facilities.
- Year-round access to the site
- No or minimal impacts from Year 2000 road construction activities
- Relatively close geographical distance between the potential sites to facilitate field activities
- Available area at the site for future BMP installation

A number of potential monitoring sites were identified within the Tahoe Basin, representing the three major categories. A field visit was conducted to each potential site. Additional information was collected at District 3 offices regarding site maps and drainage systems. Each site was then evaluated based on the available information.

2.2 Site Characteristics

A total of four monitoring sites were selected. Three of the sites are located in the Tahoe Basin representing each of the three roadway categories. A fourth site was selected in the Central Valley to supplement the sediment characterization monitoring. Locations of the three Tahoe Basin monitoring sites are presented in Figure 2-1 and the location of the Central Valley monitoring site is presented in Figure 2-2. A description of each site follows.

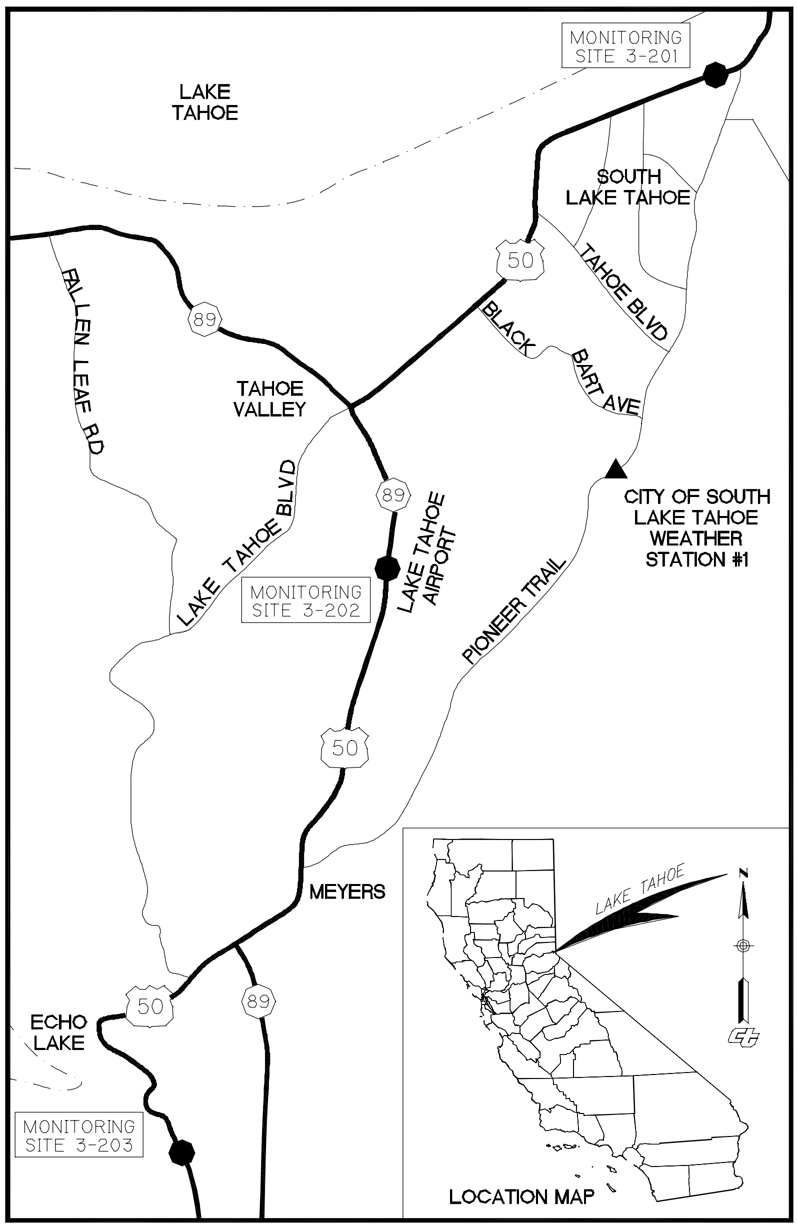


Figure 2-1 Tahoe Basin Monitoring Station Locations

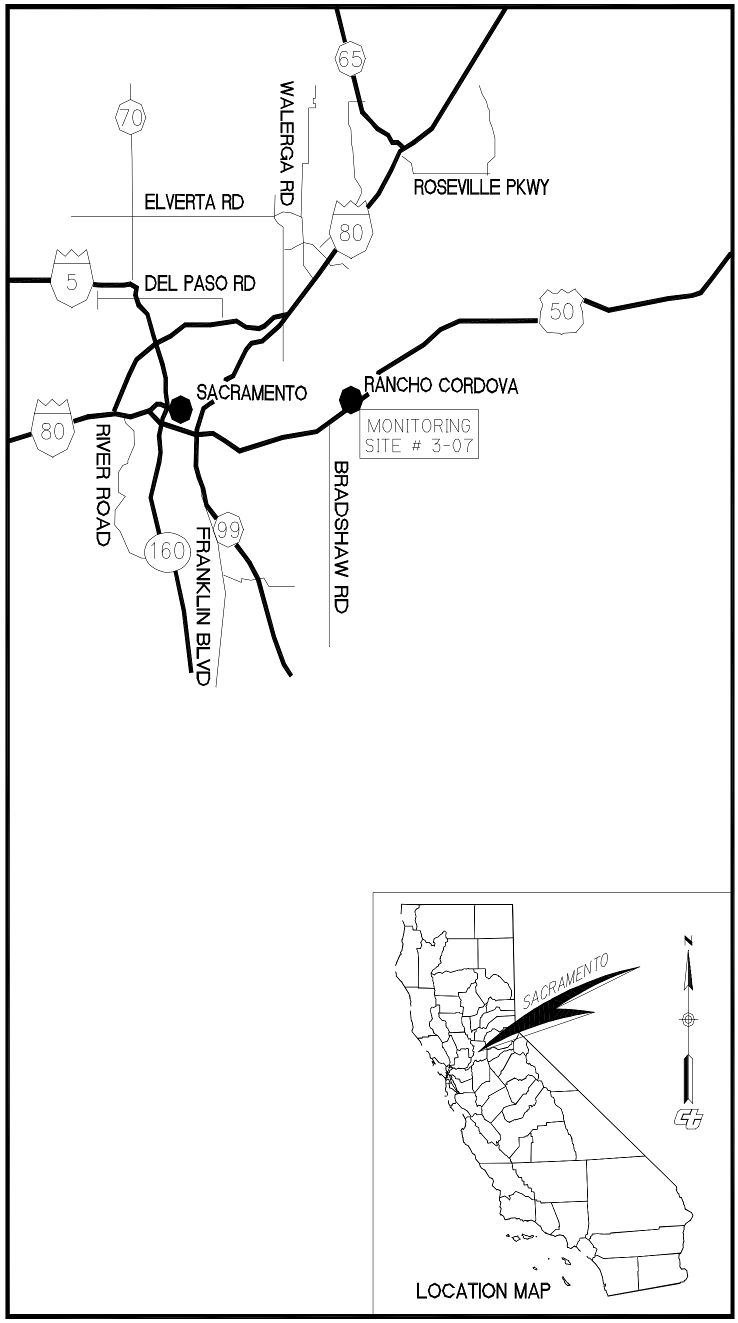


Figure 2-2. Supplemental Sediment Characterization Site Location along HY 50 at Zinfandel Road Interchange

2.2.1 Highway 50 Near the Tahoe Airport (rural lake-level elevation)

This station (ID # 3-202, 50E near Tahoe Airport) is located at the southern border of the City of South Lake Tahoe. The monitoring station is located within the right-of-way of the eastbound lane of State Highway 50, just south of H Street (post mile 74.27), near the Tahoe Airport as shown in the photos.

Tahoe Airport Monitoring Station

Highway 50 is a two-lane road at this point as shown in the photo. Only the eastbound lane drains to the curb along the eastbound lane where the station is located. Runoff from the highway flows along an asphalt curb and gutter into a double-barrel sediment trap. Runoff samples are collected at the sediment trap inlet.

The drainage area is approximately 0.3 acres. Annual average daily traffic (AADT) is published at 14,100 (Caltrans 1998 Traffic Volume Data). The site elevation is approximately 6,300 feet.

Tahoe Airport Station with Surrounding Land Use

2.2.2 Highway 50 Near Tahoe Meadows (urban lake-level elevation)

This station (ID # 3-201, 50W at Tahoe Meadows) is located within the City of South Lake Tahoe, near the state border. The monitoring station is located within the right-of-way of the westbound lane of State Highway 50, at the entrance to Tahoe Meadows residential development (post mile 79.79) as shown in the photo.

Tahoe Meadows Monitoring Station with Surrounding Land Use

Highway 50 is a four-lane road at this point. Only the two westbound lanes drain to the curb along the westbound lane where the station is located. Runoff from the highway flows along a curb and gutter and into a drain inlet. Runoff samples are collected in an 18-inch drainpipe that collects the stormwater runoff along this portion of the highway and conveys it to the Ski Run wetland treatment facilities.

The drainage area is approximately 0.8 acres. AADT is published at 37,000 (Caltrans 1998 Traffic Volume Data). The site elevation is approximately 6,250 feet.

2.2.3 Highway 50 Near Echo Summit (rural high elevation)

This station (ID # 3-203, 50E Echo Summit – El Dorado County – District 3) is located between the town of Meyers and Echo Summit. The monitoring station is located within the right-of-way of the eastbound lane of State Highway 50 at post mile 67.91 as shown in the photos.

Echo Summit Monitoring Station

Highway 50 is a three-lane road at this point along with a paved shoulder and turnout. Portions of all three lanes, the shoulder, and the turnout drain to the curb along the eastbound lane where the station is located. Runoff from the highway flows along an asphalt curb and gutter into a double-barrel sediment trap. Runoff samples are collected at the sediment trap inlet.

The drainage area is approximately 0.7 acres. AADT is published at 11,600 (Caltrans 1998 Traffic Volume Data). The site elevation is approximately 7,000 feet.

Echo Summit Monitoring Station with Surrounding Land Use

2.2.4 Sediment Monitoring Station along Highway 50 Near Zinfandel Road

A third sediment monitoring station was installed in the Central Valley for the purpose of testing the sediment monitoring equipment at a lower elevation, and to characterize sediment in the runoff at a low elevation urban setting. This station (ID # 3-07, 50E – El Dorado Co. – Dist. 3) is located within the City of Rancho Cordova (refer to Figure 2-2). The monitoring station is located within the right-of-way of the westbound lane of State Highway 50 at post mile 11.6.

Zinfandel Road Monitoring Station with Surrounding Land Use

Highway 50 is an eight-lane divided highway at this point. The four westbound lanes drain to the curb along the westbound lane where the station is located. Runoff from the highway is directed to the shoulder and along an asphalt curb and gutter before being discharged into a grassy area within the right of way. The grassy area parallels the highway and allows the runoff to infiltrate or, during high volume storm events, directs the runoff off site to the local drainage system. Water quality samples are collected after the runoff leaves the pavement but before it enters the grassy area.

The drainage area is approximately 0.7 acres. AADT is published as 127,000 (Caltrans 1998 Traffic Volume Data).

Section 3
Monitoring Methods

3.1 Introduction

Monitoring methods developed and tested for the Caltrans Tahoe Basin Stormwater Monitoring Program are presented in detail in the *Sampling and Analysis Plan (CTSW-RT-00-039)*. The *Sampling and Analysis Plan (SAP)* describes the analytical constituents, equipment and procedures applied for monitoring stormwater runoff, precipitation quality, runoff sediment size distribution and quality, and autosampler representativeness for the Tahoe Basin program. The following subsections summarize these methods for each study performed during the Tahoe Basin program.

3.2 Runoff Water Quality

The runoff water quality monitoring method used for the Tahoe Basin Program was designed to provide an estimate of the event mean concentration (EMC) for the parameters of interest. To generate a close approximation of the EMC, a series of discrete samples was collected over the course of a runoff event and combined into a single Acomposite@ sample. When the composite sample was analyzed, the results were equated to the EMC for the runoff event.

The compositing of discrete samples must be conducted on a flow-proportioned or flow-weighted basis. Developing a flow-weighted composite was accomplished for the Tahoe Basin Program by collecting the discrete samples every time a set volume of runoff passed by the monitoring station. This volume remained constant throughout the entire event and was known as the Atrigger volume”. For example, if the trigger volume was set at 5,000 cubic feet, a discrete sample was collected every time this volume was recorded.

Each of the three-runoff monitoring stations is equipped with an autosampler, a continuously recording flow meter, a continuously recording tipping bucket rain gauge, and a 12 Volt power source as shown in the photo. Monitoring equipment is housed in either a locked box enclosure or underground vault that has been installed at each of the monitoring sites.

At the two stations with double barrel sediment traps, a weir has been installed at the outlet of the second sediment trap in order to measure flow rate. At the third station, an area-velocity flow meter has been installed in an 18-inch diameter drainpipe. The flow meter calculates flow volumes from depth and velocity measurements.

The flow meter was interfaced with an autosampler. Each of the autosamplers was equipped with a single 10-Liter polyethylene sample bottle. When signaled by the flow meter, the auto samplers were pre-programmed to collect 250 milliliters (mL) of sample. Based on this configuration, a total of 40 discrete samples could be collected before the bottle had to be removed and replaced with clean empty bottle. Water quality samples were collected at the inlets to the first sediment barrel or in the drainage pipe.

The composite samples were analyzed for the minimum constituent list presented in Section 4 of the Caltrans *Guidance Manual: Stormwater Monitoring Protocols (Revised May 2000)*. In addition, the samples were also analyzed for iron (total and dissolved), turbidity, chlorides, and oil and grease. These parameters were included because they were regulated or levels tracked in the Tahoe Basin.

Monitoring of highway runoff was conducted at the three monitoring stations established in the Tahoe Basin. Monitoring targeted three separate types of runoff events: (1) summer thunderstorm events; (2) fall/spring mixed precipitation events; and (3) snow melt events. Monitoring procedures were developed and tested to determine how best to collect samples under the various environmental conditions that occur during each event.

The unpredictable nature of thunderstorms required activating the monitoring stations every day there was a significant chance for the development of afternoon storm events. The equipment programming required a high degree of flexibility to ensure a wide range of runoff volumes could be adequately sampled.

Cold weather sampling activities may be hampered by two potential difficulties that are not present in moderate and warm weather: snow accumulation and freezing of sample water in the sample line. Measures to accommodate these potential problems included:

- regular snow removal around the monitoring site,
- insulation of the sample tubing conduit,
- maintaining a positive gradient from sample intake to sampler pump,
- checking of air temperature prior to and during sample collection, and
- additional checking of the equipment by field crews,

Snowmelt runoff monitoring differs fundamentally from stormwater runoff monitoring in that sampling can be initiated in response to runoff flow in the absence of precipitation. Once substantial snowfall has occurred, field crews had to track weather conditions so as to be alert to the possibility of significant snow melt. When the desired conditions occur (warming temperatures after a period of snow accumulation or when sand and/or salts are applied to melt the snow that is falling on the roads), field crews programmed the automated equipment to collect flow-proportioned composite samples of the melting snow. This included the following modifications to the typical runoff monitoring protocols:

- Field verification of conditions
- Automated equipment programming
- Visual and photographic observations

3.3 Precipitation (Rainfall and Snowfall) Water Quality

Precipitation water quality samples were collected at two-highway runoff monitoring stations (Echo Summit and Tahoe Airport) during runoff-monitoring events, conditions permitting. Samples of "wet deposition" (rainfall and/or snowfall) were collected. Precautions were taken to minimize collection of any dry deposition or "dryfall."

Precipitation samples was collected in a high-density polyethylene (HDPE) liner that slipped into a 3.5-gallon capacity plastic bucket. The bucket with liner was pole-mounted in an area having a clear opening to the atmosphere, without vertical obstruction.

The list of analytical constituents for precipitation water quality monitoring was a subset of those constituents for the runoff samples discussed above. Precipitation samples were analyzed for the prioritized list of constituents shown in Table 3-1.

Table 3-1
Analytical Prioritization of Precipitation Constituents

High Priority Constituents: Conductivity pH Nitrate Metals (total and dissolved): Arsenic Cadmium Chromium Copper Iron Lead Nickel Zinc	**Mid-Level Priority Constituents:** Hardness Chloride **Low-Level Priority Constituents:** Phosphorous Orthophosphate TKN

3.4 Sediment Size Distribution and Quality

A passive filtration collection system was developed to collect sediments for characterization of particle size distribution, chemical composition, and mass. This system used filter fabric bags and filter fabric sheets to collect sediment entrapped in the runoff. The bags and sheets were applied separately or in combination.

The filter bags were installed in the double barrel sediment traps. The bags were anchored in the bottom of the barrels as shown in the photograph. Any material that settled to the bottom would fall into the bag. The bags were made of 0.02 mm material that allowed water to drain away but retained all materials larger than 0.02 mm.

The filter sheets were installed in a stacked filter box that received the outflow from the sediment traps or runoff directly from the roadway. Three successively smaller pore diameter sheets (0.075, 0.038, and 0.020 mm) were used to filter sediments. Example of the filter box with the three filters is shown in the photograph.

The filter bags and filter sheets were periodically collected for analysis. The filter sheets were collected when sufficient material had accumulated and water no longer drained through in a reasonable time to prevent bypassing. The filter bags were collected as weather permitted (i.e., system free of ice).

Sediment samples were characterized in terms of mass, particle size distribution and chemical content. Mass was calculated for dry weight. ASTM D422 was applied to determine the particle size distribution. The sediment was then analyzed for parameters listed in Table 3-2.

Table 3-2
Sediment Sample Laboratory Analyses

Constituent	EPA Analytical Method	Reporting Limit (mg/kg)	Required Mass/ Volume	Sample Preservation	Maximum Hold Time
Total Phosphorus	EPA Method 365.3	1	2 g	Chilled	28 days
Total Organic Carbon	EPA Method 415.1	50	2 g	Chilled	28 days
Total Nitrogen	EPA Method 351.4	1	2 g	Chilled	48 hours
Arsenic	EPA Method 6010	0.5	1 g	Chilled	6 months
Cadmium		0.5			
Chromium		0.5			
Copper		0.5			
Lead		5			
Nickel		2.5			
Zinc		0.5			
Iron		0.5			

3.5 Autosampler Representativeness

A manual grab sampling procedure was implemented in conjunction with the autosamplers used to collect water quality samples (see Section 3.2). During storm water runoff events, both systems were implemented concurrently to enable evaluation of the effectiveness of the autosampler for collecting representative sediment samples. A series of grab samples of storm water runoff were manually collected using a container of known volume near the same point where the strainer to the autosampler was located. The manual samples were collected coincident with the increments collected by the autosampler, i.e., whenever the autosampler collected a sample, the same sample volume was collected in the bucket. The only difference was that the sample collected by the container represented the entire flow, not just the portion near the strainer.

Each sample collected by the autosampler and the manual method were filtered through a 1 micron pore diameter cellulose fiber filter using a vacuum extractor. The mass of sediment retained on the filter from the autosampler sample was compared with the mass obtained from the sample of the water volume (manual) method. In addition, selected samples were analyzed for particle size distribution using the Sedgewick-Rafter particle counting method (Standard Methods for the Examination of Water and Wastewater, 10200 E, Microscopes and Calibrations, and 10200F, Phytoplankton Counting Techniques).

Section 4
Field Data and Analytical Results: Precipitation and Runoff Quality

4.1 Precipitation

4.1.1 Background

Two of the three Tahoe Basin monitoring stations were equipped with continuously recording tipping-bucket rain gages. However, the rain gages were not equipped to measure precipitation in the form of snow or freezing rain. Consequently, the on-site equipment could not measure the majority of the precipitation that occurred in the Tahoe Basin during the monitoring period.

Monthly precipitation data collected at stations located at the Meyers Fire Station and in the City of South Lake Tahoe and Tahoe City were used to supplement the data set at the two Caltrans stations. All stations are located in the Tahoe Basin. Precipitation monitoring has been performed on and off at the Meyers Fire Station since 1956 and continuously at the Tahoe City station since 1909. The City of South Lake Tahoe installed a weather station with heated rain gage in the fall of 2000. The average monthly totals and annual totals were compiled as a means of qualifying the representativeness of the 2000-20001 monitoring season. Additional snow pack information was compiled from 13 other monitoring stations located in the Tahoe Basin and Echo Summit area.

4.1.2 Precipitation Data Summary

Precipitation in the form of scattered thunderstorms started in August 2000. Several events with rain, rain/snow mixture, and light snow conditions occurred throughout September, October, and November 2000. The first freezing conditions of the 2000-2001 season to impact rainfall measurements occurred during an event on October 9, 2000 at both Caltrans stations. The first snow management activity of the season was performed by Caltrans during an event on October 1, 2000. According to California Department of Water Resources (DWR) published records, the first significant snow accumulation occurred at the end of November 2000. The snow accumulation peaked in terms of water content around the second week in March 2001. The snow pack disappeared at lake level (elevation 6250 feet) around the end of March 2001 and from the Echo Peak area (elevation 7800 feet) during the second week in May 2001. Precipitation events were recorded through the month of April 2001.

4.1.3 Comparison with Historical Data

A comparison was made between long-term historical rainfall averages from the Meyers Fire Station and Tahoe City Stations and the rainfall that fell during the 2000-

2001 monitoring season. Both monthly totals and seasonal totals (October 2000 through April 2001) were used in this evaluation.

Table 4-1 shows monthly totals for the period October through April, starting with the 2000/2001 season and followed by the historical average calculated for the period of record (POR). The total for the October to April period is shown in the last column of the table.

Precipitation during the 2000-2001 monitoring period was significantly less than average totals. Lower than average totals occurred in November, December, February, and March as shown in Table 4-1. The total volume for the October to April period was less than sixty percent of the average at both stations. Rainfall during the 2000-2001 season exceeded the historical averages only during the months of October and April. Monthly totals were also exceeded in August and September, which have not been included in the table. Other stations in the North Lahontan hydrologic region reported similar precipitation totals to the Department of Water Resources. Total precipitation for the October 2000 to April 2001 period was around 50 percent of the average for the region.

Table 4-1 Monthly and Historical Precipitation Data

Months	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	Total
City of South Lake Tahoe								
Water Year 2000/2001	N/A	N/A	N/A	0.80	1.69	0.89	1.98	N/A
Meyers Fire Station								
Water Year 2000/2001	1.84	1.21	1.61	2.09	3.33	1.24	4.22	15.54
Historical Average *	1.72	3.34	5.09	5.86	5.24	4.10	2.37	27.73
Tahoe City Station								
Water Year 2000/2001	2.57	1.95	1.53	1.88	4.86	1.56	---	14.35
Historical Average	1.90	3.46	5.69	6.18	4.94	3.79	---	25.96

* Based on 31 seasons starting with water year 1955

4.2 Runoff Flow Data

4.2.1 Background

All three Tahoe Basin monitoring stations were equipped with flow measurement devices and continuously recording dataloggers. At the two rural sites located near the Tahoe Airport and Echo Summit, flow was determined by measuring the depth of flow over a weir that had been installed at the outlet of the double barrel sediment trap. At the urban station near Tahoe Meadows, flow was determined using an area-velocity probe.

The flow meters were installed at the two Tahoe Airport and Echo Summit stations toward the end of July 2000 and monitored flow through the end of April 2001. The flow meter at the Tahoe Meadows site was installed toward the end of September 2000 and monitored flow through the end of April 2001. Depth, velocity, and flow rates were recorded at five-minute intervals.

4.2.2 Flow Data Summary

Runoff was generated at all three stations in response to either a rainfall event or snowmelt. When temperatures were above freezing, the precipitation occurred as rain. Runoff was generated shortly after the rainfall began and continued for the duration of the rain event. The runoff continued for a short time after the rain ceased but would dropped off rapidly to zero. This pattern was a reflection of the small drainage area at all three sites. Changes in the rate of flow were in response to a change in rainfall intensity with higher rainfall intensities producing higher runoff rates.

When the air temperatures were below freezing, the precipitation fell as snow or freezing rain. If the ground was not frozen such as in the early fall or late spring, the snow or ice would melt upon reaching the ground and generate runoff. If the ground was frozen, the snow or ice accumulated on the ground or roadway and remained in place. When the air temperature rose above the freezing point, any accumulated snow or ice would begin to melt and runoff would be produced. The runoff continued until temperatures fell below freezing. Changes in the rate of flow were in response to changes in the air temperature with warmer temperatures producing higher runoff rates.

Daily weather records indicated air temperatures often rose above freezing for a portion of the day in the Tahoe Basin throughout the winter season. There were days when temperatures never rose above freezing but during other days, this warming trend occurred between 11 AM and 5 PM. Runoff would be produced during such periods as long as snow remained on the ground. Once all the snow had melted, no more runoff was produced until the next snow event. Once the temperature dropped below zero degrees Centigrade after sunset, the melt water soon froze again and the runoff ceased. Figure 4-1 presents an actual hydrograph showing a multiple-day runoff cycle from Station 4-1, Tahoe Airport.

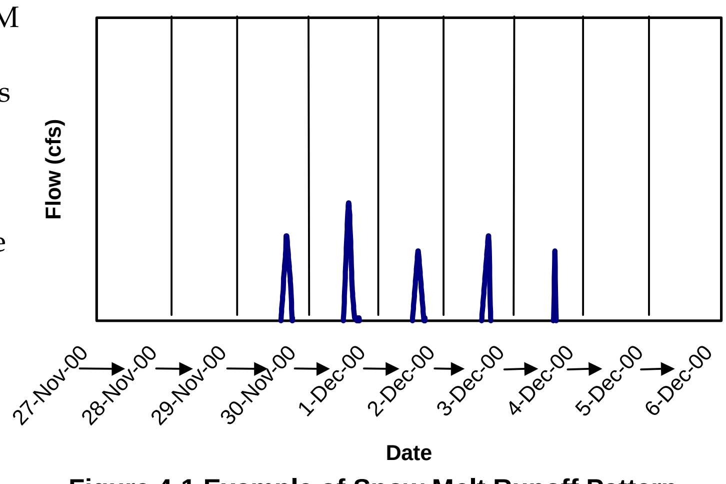


Figure 4-1 Example of Snow Melt Runoff Pattern from Station 3-202

Snow management activities conducted by Caltrans along the roadways also impacted the timing and amount of runoff. In response to snow and freezing rain events, Caltrans would perform one or more of the following activities:

- Application of sand and salt to aid in traction;
- Plowing the snow off the active traffic lanes;
- Collecting the snow from the right of way and trucking it to an off-site disposal yard, a practice typically performed in the urban area of South Lake Tahoe; and
- Returning after a snow event to remove any remaining snow from the roadway, shoulder and gutter.

The application of sand and salt caused the snow and ice to melt at lower temperatures and sometimes runoff was produced during periods when the air temperature was at or below freezing. This was a common occurrence at the Tahoe Meadows site in South Lake Tahoe. Runoff was commonly recorded during snowfall events regardless of the air temperature.

The plowing and collecting of snow to remove it from the surface of the roadways reduced the amount of snow available to generate runoff. The majority of the snow was typically removed from the drainage area before it had a chance to melt. The snow was collected and trucked to a disposal site; blown well into the woods adjacent to the roadway; or plowed beyond the curb and out of the drainage area so very little melt water drained back onto the road.

As a result, rainfall events produced higher volumes of runoff and peak flow rates than snow melt events. All the rain that fell in the drainage area passed through the monitoring location within a relatively short period. Only a portion of the snow that fell within the drainage area was allowed to remain in the drainage area until it melted. Melting itself was a very slow process that often occurred over several days with only a small amount of runoff generated on each of the days.

The flow meter at the Tahoe Meadows site (lake-level urban) functioned throughout the entire monitoring season. The below ground installation prevented the equipment and flow in the storm drain from freezing. Flow rates ranged from 0.01 to 0.65 cubic feet per second (cfs). The peak rates occurred during rainfall events. Flow rates during snow or snowmelt events rarely exceeded 0.2 cfs. The duration of runoff events typically ranged from one to eight hours. Several events lasted longer than 24 hours. Runoff occurred during snow events and on the day following an event if the temperature rose above freezing. Volumes for runoff events ranged from below 100 to 2,900 cubic feet (cf). No local rainfall data were available to calculate a runoff coefficient. The coefficient was estimated to be 0.9 due to the drainage area being comprised entirely of a recently paved section of Highway 50 with a new curb and gutter. Storm Event Summaries for each of the monitored events are provided in Appendix A and provide additional information on flow rates and volumes.

The flow meter at the Tahoe Airport site (lake-level rural) was impacted by freezing conditions and regular maintenance was required to keep the meter recording accurate water levels. Ice would build up around the end of the bubbler tube, the weir and the inside of sediment barrels and had to be removed. Even with regular maintenance, there were periods when the flow records were inaccurate due to the ice buildup.

Flow rates at the Tahoe Airport site ranged from 0.01 to 1.0 cfs. The peak rates occurred during rainfall events. Flow rates during snowmelt events rarely exceeded 0.1 cfs. The duration of runoff events typically ranged from four to eight hours. Runoff from snow melt events rarely occurred during the actual event, but started on the first day following an event when the temperatures rose above freezing. Runoff volumes for runoff events ranged from below 100 to 1,200 cf. A comparison to local rainfall volumes to the runoff volumes indicates the runoff coefficient was about 0.8 for this drainage area. Storm Event Summaries for each of the monitored events are provided in Appendix A and provide additional information on rainfall and runoff.

The flow meter at the Echo Summit site (high-elevation rural) was also impacted by the buildup of ice around the bubbler line, the weir and inside the sediment trap. Regular maintenance was performed to keep the meter recording accurate water levels. In addition, plowing activities created a snow berm that at times caused runoff to bypass the sediment trap and monitoring station. Maintenance activities included breaking down this berm and directing flows to the sediment trap.

Example of Snow Accumulation Along Gutter at Echo Summit

The Echo Summit site received more snow than at the other two Tahoe sites based on visual observations. The entire drainage area was not cleared of snow after each event as at the other two sites. The Echo Summit drainage area contained three traffic lanes, a wide paved shoulder, a paved turnout, and a curb. Snow was often left along the outside edge of the shoulder and in the turnout as shown in the photograph. Snowmelt and the accompanying runoff extended for longer periods due to the accumulation of snow in these outlying areas and the colder temperatures at this higher elevation.

Flow rates at the Echo Summit site ranged from 0.01 to 1.0 cfs. The peak rates occurred during rainfall events. Flow rates during snowmelt events rarely exceeded 0.1 cfs. The duration of runoff events typically ranged from four to eight hours. Runoff from snow melt events rarely occurred during the actual event, but started on the first day following an event when the temperatures rose above freezing. Runoff volumes for runoff events ranged from less than 100 to 3,500 cf. A comparison to local rainfall volumes to the runoff volumes indicates the runoff coefficient was about 0.9 for this drainage area. Storm Event Summaries for each of the monitored events are provided in Appendix A and provide additional information on rainfall and runoff.

4.3 Runoff Water Quality Data

4.3.1 Background

All three Tahoe Basin monitoring stations were equipped with autosamplers for collecting flow-weighted composite samples. The composite samples were analyzed for the suite of parameters that had been established for this study and discussed in Section 3.2 in the SAP. The results of these analyses provided the data to begin the characterization of runoff quality in the Tahoe Basin.

The autosamplers were installed at the Tahoe Airport and Echo Summit stations toward the end of July 2000 and were activated through the end of April 2001. The autosampler at the Tahoe Meadows site was installed toward the end of September 2000 and activated through the end of April 2001.

4.3.2 Runoff Analytical Data Summary

Table 4-2 summarizes the analytical data generated by the 2000-2001 Tahoe Basin monitoring programs. The Caltrans data analysis tool (DAT) was applied to generate the statistical values listed in the table. The data summaries are presented in terms of the reporting limits, units, number of samples, range of EMC values, the mean of all EMC data, the median of all the EMC data, standard deviation, and the coefficient of variation. Only the data meeting the quality objectives of the project were used to generate this summary. Any data point flagged in Appendix B as inappropriate for use by Caltrans was not included in this summary or any further evaluation.

All the storm water runoff analytical data generated during the 2000-2001 monitoring season are provided in tabular format in Appendix B, Tables B.1, B.2, and B.3. The data are listed by station number and storm event for each parameter. Any QA/QC flag assigned to an individual data point is shown with the data.

QA/QC procedures were implemented for the sample collection and analysis portions of the Tahoe Basin Study to ensure that the water quality data were of known quality and met the project objectives. Procedures were established for both field and laboratory work. A discussion of the QA/QC review process and results is included in Appendix F.

Table 4-2 Summary of Runoff Water Quality Data from All Tahoe Basin Sites

Constituent / Parameter	Units	Reporting Limit	Sample Size	Range		Mean	Median	Standard Deviation	CV
				Min	Max				
Conventionals									
pH	pH units	0.1	22	5.6	8.5	7.3	7.3	0.8	0.11
EC	umhos/cm	1	22	39	16200	2400	1026	4027	1.68
TSS	mg/L	1	22	25	5100	989	608	1334	1.35
TDS	mg/L	1	22	27	8780	1854	898	2420	1.31
Hardness as CaCO3	mg/L	2	22	6	412	94	74	96	1.03
DOC	mg/L	1	22	4	65	22	17	16	0.72
TOC	mg/L	1	22	4	81	25	21	19	0.74
Turbidity	NTUs	0.05	19	8	2620	575	493	644	1.12
Chloride	mg/L	0.02	21	3	5300	1069	510	1454	1.36
Oil & grease	mg/L	5	3	5	7	4	NA	NA	NA
Nutrients									
Nitrate (as N)	mg/L	0.1	20	0.1	1.0	0.4	0.3	0.2	0.61
TKN	mg/L	0.1	21	0.3	5.6	1.6	0.8	1.6	0.99
Total Phosphorus	mg/L	0.03	22	0.08	9.90	1.30	0.55	2.46	1.90
Diss. Orthophosphate	mg/L	0.03	22	0.03	0.38	0.11	0.10	0.09	0.78
Total Metals									
Arsenic	ug/L	0.5	22	0.7	25.5	6.1	5.5	5.8	0.94
Cadmium	ug/L	0.2	20	0.3	3.0	1.0	0.9	0.8	0.72
Chromium	ug/L	1	22	4	120	28	24	28	0.98
Copper	ug/L	1	22	16	170	55	44	35	0.64
Iron	ug/L	25	20	1540	162000	32802	22000	41092	1.25
Lead	ug/L	1	22	5	367	66	51	86	1.30
Nickel	ug/L	2	22	4	67	19	15	15	0.77
Zinc	ug/L	5	22	39	1030	359	289	238	0.66
Dissolved Metals									
Arsenic	ug/L	0.5	21	0.6	20.1	2.6	1.3	5.1	1.97
Cadmium	ug/L	0.2	20	NA	NA	NA	NA	NA	NA
Chromium	ug/L	1	20	1	12	4	4	3	0.64
Copper	ug/L	1	22	3	42	13	10	10	0.76
Iron	ug/L	25	20	41	8970	832	334	2569	3.09
Lead	ug/L	1	21	1	11	2	1	3	1.66
Nickel	ug/L	2	21	2	14	4	3	3	0.90
Zinc	ug/L	5	22	9	283	56	32	67	1.21

CV = Coefficient of variation
NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Composite samples were collected of the three types of runoff events targeted for the Tahoe Basin Study. These event types included summer thunderstorms, rain or mixed rain/snow, and snowmelt. Table 4-3 identifies by monitoring station the number of events successfully monitored for each event type. No summer thunderstorms were monitored at the Tahoe Meadows station because the station was installed after the season ended in late September 2000.

The autosampler installed at the Tahoe Meadows station (lake-level urban) functioned throughout the entire monitoring season. The below ground installation prevented the equipment and flow in the storm drain from freezing. The small volume of runoff produced during snowmelt events sometimes prevented water quality samples from being collected. The depth of flow was too shallow for the autosampler to draw up the sample.

Table 4-3 Summary of Monitoring Events by Event Category

Event Category	Station 3-201 Tahoe Meadows	Station 3-202 Tahoe Airport	Station 3-203 Echo Summit
Summer Thunderstorm	—	1	2
Rain or Rain/Snow mix	3	2	2
Snowmelt	3	5	4

The autosamplers installed at the Tahoe Airport and Echo Summit stations performed better than expected. The only major impact was the strainer becoming encased in ice. Runoff could not be drawn into the sample tube when this occurred. Keeping the strainer free of ice became a regular maintenance activity.

The sun heated the metal housing units, which caused the inside temperature to be sufficiently warm enough for the autosampler to operate properly. Maintaining a positive slope in the sample tubing from the strainer to the autosampler prevented any problems under freezing conditions because any remaining sample was either purged or simply drained out before it had a chance to freeze.

Again, shallow flow depths prevented the collection of samples during certain events. To improve the success, only events that were forecasted for significant rainfall volumes (greater than 0.2 inches), snowfall volumes (greater than 5 inches), or warm weather following a snowfall (greater than 5 degrees Centigrade) were targeted.

4.4 Precipitation Quality

4.4.1 Background

The Tahoe Airport and the Echo Summit monitoring stations were equipped with a sampler to collected precipitation for analytical analysis. The collected samples were analyzed for the suite of parameters that had established for this study and listed in the SAP. The results of these analyses also provided the data to begin the characterization of runoff quality in the Tahoe Basin.

The precipitation samplers were installed at the Tahoe Airport and Echo Summit stations in January 2001 and were active through the end of April 2001. A sampler could not be safely installed at the Tahoe Meadows site.

4.4.2 Precipitation Analytical Data Summary

Table 4-4 summarizes the precipitation analytical data generated by the 2000-2001 Tahoe Basin monitoring programs.

Table 4-4 Summary of Precipitation Quality Data from Tahoe Basin Sites

Constituent / Parameter	Units	Reporting Limit (RL)	Sample Size	Percent > RL	Mean
Conventionals					
pH	pH units	0.1	6	100	6.1
EC	umhos/cm	1.0	6	100	50
TSS	mg/L	1.0	8	75	9
TDS	mg/L	1.0	8	63	29
Hardness as CaCO3	mg/L	2.0	4	100	7
DOC	mg/L	1.0	4	75	2
TOC	mg/L	1.0	4	50	1.6
Turbidity	NTUs	0.1	2	100	7
Chloride	mg/L	1.0	8	63	9
Nutrients					
Nitrate (as N)	mg/L	0.1	8	50	0.2
TKN	mg/L	0.1	4	75	0.3
Total Phosphorus	mg/L	0.03	4	50	0.06
Diss. Orthophosphate	mg/L	0.03	2	ND	NA
Total Metals					
Arsenic	ug/L	0.5	8	25	0.8
Cadmium	ug/L	0.2	8	13	0.1
Chromium	ug/L	1.0	8	75	6.0
Copper	ug/L	1.0	8	100	7.0
Iron	ug/L	25.0	4	100	1151
Lead	ug/L	1.0	8	88	2.0
Nickel	ug/L	2.0	8	25	3.0
Zinc	ug/L	5.0	8	100	92.0
Dissolved Metals					
Arsenic	ug/L	0.5	8	ND	NA
Cadmium	ug/L	0.2	8	ND	NA
Chromium	ug/L	1.0	8	13	0.6
Copper	ug/L	1.0	8	50	3.0
Iron	ug/L	25.0	4	100	38
Lead	ug/L	1.0	8	ND	NA
Nickel	ug/L	2.0	8	ND	NA
Zinc	ug/L	5.0	8	100	52.0

ND = Not detected above the laboratory reporting limits (RLs) in any of the samples.
NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

The data summaries are presented in terms of the units, reporting limits, number of samples, percentage of values greater than the reporting limits, and the average value of the dataset. Only the data meeting the quality objectives of the project were used to generate this summary. Any data point flagged in Appendix B as inappropriate for use by Caltrans was not included in this summary or any further evaluation.

Samples were collected for two of the three types of runoff events targeted for the Tahoe Basin Study. These event types included mixed rain/snow (1 event) and snow (three events).

Collecting a sample of sufficient volume was the most challenging aspect of monitoring for precipitation quality. Close to one inch of rain or melted snow was needed to generate sufficient sample volume so all the required analytical tests could be run. A priority scheme was established when the sample volume was less than the minimum volume and only a portion of the tests could be performed. During snow events, undisturbed snow that had fallen well away from the road was sometimes collected to supplement the snow collected by the sampler.

All the storm water runoff analytical data generated during the 2000-2001 monitoring season are provided in tabular format in Appendix B, Tables B-4 and B-5. The data are listed by station number and storm event for each parameter. Any QA/QC flag assigned to an individual data point is shown with the data. A discussion of the QA/QC results is included in Appendix F.

Section 5
Field Data and Analytical Results: Sediment Characterization

5.1 Runoff Sediment Characterization Results

Sediment for the Tahoe Basin Study was characterized in terms of mass (gravimetric), particle size distribution, and chemical content. Samples of sediment found in the runoff were collected at two types of highway sites, double barrel sediment traps and surface drainage systems.

At the sediment traps, the contents of the up-gradient barrel and down-gradient barrel were removed periodically for analysis. Effluent or overflow from the traps was directed to a filter box were a series of three filters were designed to remove sediment and other materials that were 0.02mm or larger from the flow stream. These filters were also periodically removed and the contents collected.

At the surface drainage sites, runoff was directed to the filter box right after if exited the pavement. Once again a series of three filters were designed to remove sediment and other materials larger than 0.02mm. Filters were installed on a single event basis.

Table 5-1 summarizes the samples collected for the sediment characterization study and the analyses conducted on these samples. The table lists samples that were collected and the analyses performed for both the test sites and the specific monitoring stations.

Table 5-1 Sediment Characterization Sample Collection and Analysis Summary

Test Site	Monitoring Station	Monitoring Period	Sample	Analyses [1]			
				Gravimetric [2]	Grain Size [3]	Particle Count [4]	Chemical [5]
Double Barrel Sediment Trap	Station 3-203 HY 50 near Echo Summit	1/29/01 – 2/28/01	Effluent [6]	X	X	–	X
		2/28/01 – 3/25/01	Effluent [6]	X	X	X	X
		Spring 2000 – 4/4/01	Barrel Contents [7]	X	X	–	X
		3/25/01 – 5/02/01	Effluent [6]	X	X	–	X
		4/2/01 – 5/02/01	Barrel Contents [8]	X	X	–	X
	Station 3-202 HY 50 at Tahoe Airport	1/29/01 – 2/28/01	Effluent [6]	X	X	X	X
		2/28/01 – 4/4/01	Effluent [6]	X	X	X	X
		1/29/00 – 4/2/01	Barrel Contents [8]	X	X	–	X
		4/4/01 – 5/2/01	Effluent [6]	X	X	–	X
		4/2/01 – 5/2/01	Barrel Contents [8]	X	X	–	X
Highway Runoff	Station 3-07 HY 50 at Zinfandel	1/29/01 – 2/10/01	Direct runoff [9]	X	X	–	–
		3/22/01 – 3/27/01	Direct runoff [9]	X	X	X	X
		4/4/01 – 4/9/01	Direct runoff [9]	X	X	–	X

Notes:

[1] "X" = Analyzed and "–" = Not analyzed.

[2] Gravimetric analyses conducted at CDM Laboratory, Denver CO.

[3] Grain size distribution analyses (ASTM D422) conducted by Goodsen and Associates, Denver CO.

[4] Particle count analyses conducted using Standard Methods for the Examination of Water and Waste Water, 10200 E (Microscopes and Calibrations) and 10200F (Phytoplankton Counting Techniques).

[5] Chemical analyses conducted by CalScience Labs.

[6] Effluent from double barrel sand traps, sediment collected in filter box equipped with three stacked filters.

[7] Samples of the contents from both the up-gradient and down-gradient barrels were collected. During this round of sampling sediment samples were collected from a sediment trap located on Highway 89 near Luther Pass. This site was used as a surrogate sampling site when Caltrans cleaned the Station 3-203 sediment-trap barrels before the samples were collected.

[8] Contents from both the up-gradient and down-gradient barrels were collected.

[9] Highway runoff was directed to a filter box equipped with three screens for filtering out any sediment.

The sediment sampling procedures and equipment were developed for the Tahoe Basin study. Both the procedures and equipment provided the means to collect the desired samples. However, several problems were encountered. The up-gradient barrels in the sediment traps collected large amounts of sediments (hundreds of pounds) which posed a logistical problem for removal and handling. Another problem that was encountered was the clogging of the filters in the stacked boxes with either sediment or ice. The clogging caused the flow to back up and bypass the filter box. Collecting the contents of both the barrels and filter boxes on a more frequent basis may solve these two problems.

5.1.1 Gravimetric Results

All the gravimetric or mass measurement results for storm water sediments collected during this investigation are provided in Appendix C. The results represent dry weight of the material collected from the sediment trap barrels or from the filter boxes. Gravimetric analyses were conducted according to the methods described in Sections 3.4 and detailed in *Standard Operating Procedure, Passive Filtration System*. Table 5-2 summarizes the results for specific monitoring periods at each test location and monitoring station.

Table 5-2 Summary of Gravimetric Analyses for the Sediment Characterization Study

Location	Sample	Collection Period	Beginning Date	Ending Date	Mass (g)
Station 3-203 Echo Summit	Sediment Trap Effluent	Period 1	1/29/01	3/25/01	9,755
	Up-gradient Barrel [1]	Period 1	1/29/01	3/25/01	829,500
	Down-gradient Barrel [1]	Period 1	1/29/01	3/25/01	139,000
	Sediment Trap Effluent	Period 2	3/25/01	5/2/01	5,074
	Up-gradient Barrel	Period 2	4/2/01	5/2/01	52,467
	Down-gradient Barrel	Period 2	4/2/01	5/2/01	10,254
Station 3-202 Tahoe Airport	Sediment Trap Effluent	Period 1	12/29/00	4/4/01	4,439
	Up-gradient Barrel	Period 1	12/29/01	4/2/01	72,072
	Down-gradient Barrel	Period 1	12/29/01	4/2/01	16,088
	Sediment Trap Effluent	Period 2	4/4/01	5/2/01	2,693
	Up-gradient Barrel	Period 2	4/2/01	5/2/01	7,526
	Down-gradient Barrel	Period 2	4/2/01	5/2/01	8,923
Station 3-07 Zinfandel	Direct Runoff	Period 1	12/29/00	1/10/01	6,557
	Direct Runoff	Period 2	3/22/01	3/27/01	2,423
	Direct Runoff	Period 3	4/4/01	4/9/01	6,463

[1] Estimated from sediment depth measurements.

5.1.2 Particle Size Distribution Results

Particle size distributions of the sediment samples collected from the sand traps and filter boxes were analyzed according to ASTM D422. All the results are presented in Appendix D. Tables 5-3 through 5-8 summarize these results. The results are shown in both tabular and graphical formats. Table 5-3 summarizes the particle size distributions from all three of the monitoring stations. Tables 5-4 and 5-5 summarize the size distribution results for the two collection periods at Monitoring Station 3-203, Echo Summit. Tables 5-6 and 5-7 summarize the particle size distribution results for the two collection periods at Monitoring Station 3-202, Tahoe Airport. Table 5-8 summarizes the distribution results for the three collection periods (filter box only) at Monitoring Station 3-07, Zinfandel Road.

Table 5-3 All Monitoring Station - Grain Size Distribution Results

Diameter (mm)	Mass Finer (%)		
	Station 3-203 Echo Summit	**Station 3-202 Tahoe Airport**	**Station 3-07 Zinfandel Road**
12.7	100.0	100.0	100.0
9.525	100.0	96.9	99.1
4.75	99.8	95.7	92.1
2.36	96.4	90.5	81.0
2	94.5	89.1	78.4
1.18	83.4	75.9	70.4
0.85	71.2	68.8	64.1
0.6	55.4	60.0	56.6
0.425	41.8	52.5	48.1
0.3	31.5	46.4	38.8
0.15	16.3	35.1	19.4
0.075	10.0	27.8	11.0
0.0716	2.8	11.0	1.5
0.051	2.6	10.5	1.4
0.0328	2.4	9.9	1.3
0.0196	1.8	8.7	1.2
0.0141	1.6	7.5	1.0
0.0102	1.3	6.5	0.9
0.0055	0.9	4.2	0.7
0.0024	0.6	2.4	0.6

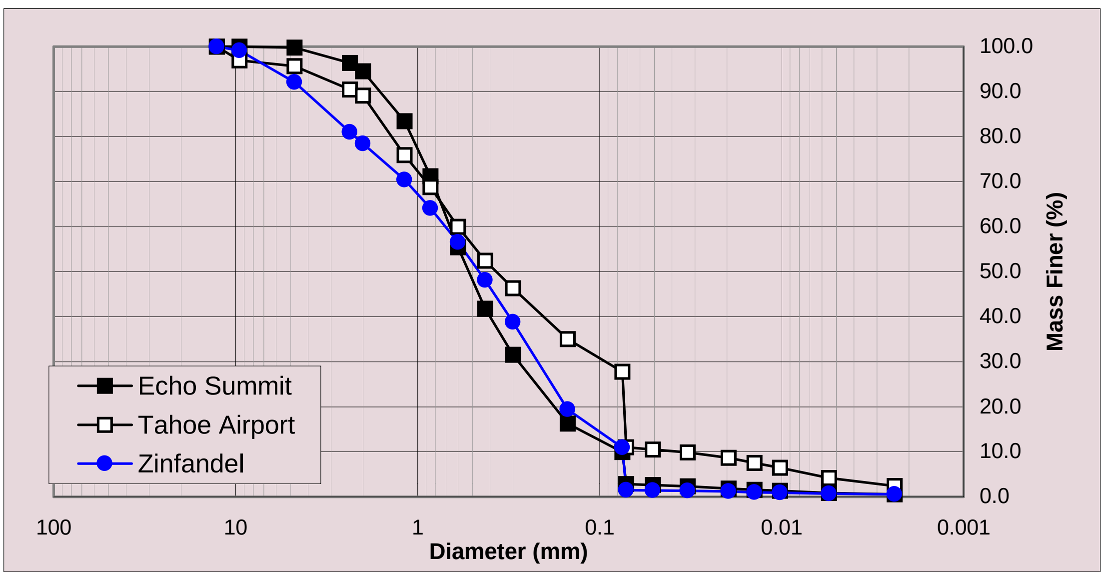


Table 5-4 Monitoring Station 3-203 (Echo Summit) - Period 1 - Grain Size Distribution Results

Diameter (mm)	Mass Finer (%)			
	Up-gradient Barrel (4/04) [1]	Down-gradient Barrel (4/04) [1]	Effluent (1/29 - 2/28)	Effluent (2/28 - 3/25)
12.7000	100	100	100	100
9.5250	100	100	100	100
4.7500	99.8	100	100	100
2.3600	96.3	100	100	100
2.0000	94.2	100	99.9	100
1.1800	83.4	86.5	99.9	99.9
0.8500	70.6	76.1	99.8	99.6
0.6000	52.8	68.6	99.7	99.5
0.4250	37.1	64.2	99.5	99.2
0.3000	25.5	59.9	99.3	99
0.1500	8.2	53.4	98.6	95.2
0.0750	2.4	45.6	96.3	72.1
0.0716	0.1	15	94.6	25.1
0.0510	0	14.1	92.1	23.1
0.0328	0	12.9	87.2	19
0.0196	0	9.8	77.3	12.8
0.0141	0	8.6	72.3	10.6
0.0102	0	7.2	62.4	8.6
0.0055	0	4.8	30.2	5.9
0.0024	0	3.2	15.4	4.6

[1] Highway 89 Surrogate

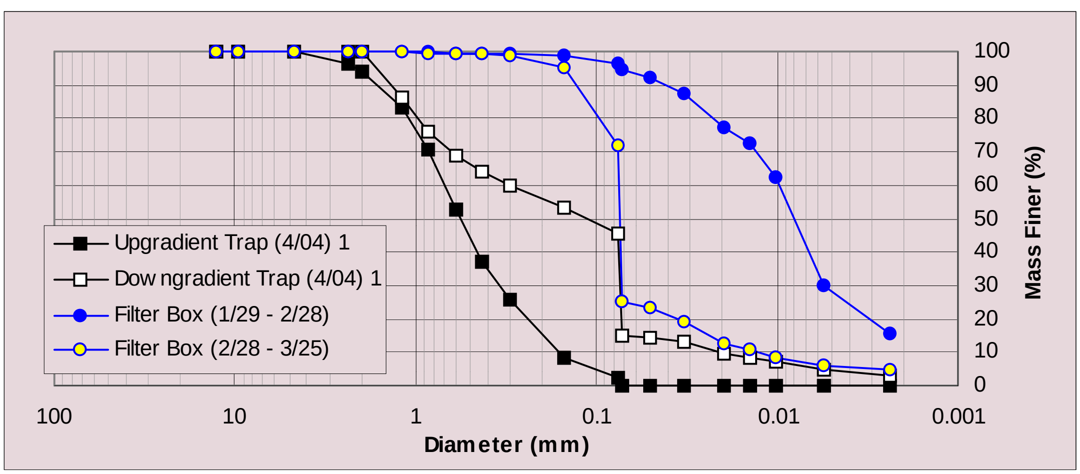


Table 5-5 Monitoring Station 3-203 (Echo Summit) - Period 2 - Grain Size Distribution Results

Diameter (mm)	Mass Finer (%)		
	Up-gradient Barrel (4/02 - 5/02)	Down-gradient Barrel (4/02 - 5/02)	Effluent (3/25 - 5/02)
12.7000	100	100	100
9.5250	100	100	100
4.7500	98.9	100	100
2.3600	86.8	100	99.7
2.0000	82.6	100	99.6
1.1800	67.8	100	99.4
0.8500	54.3	99.9	99.3
0.6000	41.2	99.4	98.9
0.4250	29.1	99	98.6
0.3000	19.7	98.5	98.1
0.1500	8.1	94	94.5
0.0750	3.5	78.8	74.9
0.0716	0.2	31.3	28.3
0.0510	0.1	30.3	26.6
0.0328	0.1	27.6	22.4
0.0196	0.1	24.4	16.4
0.0141	0.1	21.3	13.9
0.0102	0.1	16.6	12.2
0.0055	0.1	12.2	7.9
0.0024	0.1	8.3	5.4

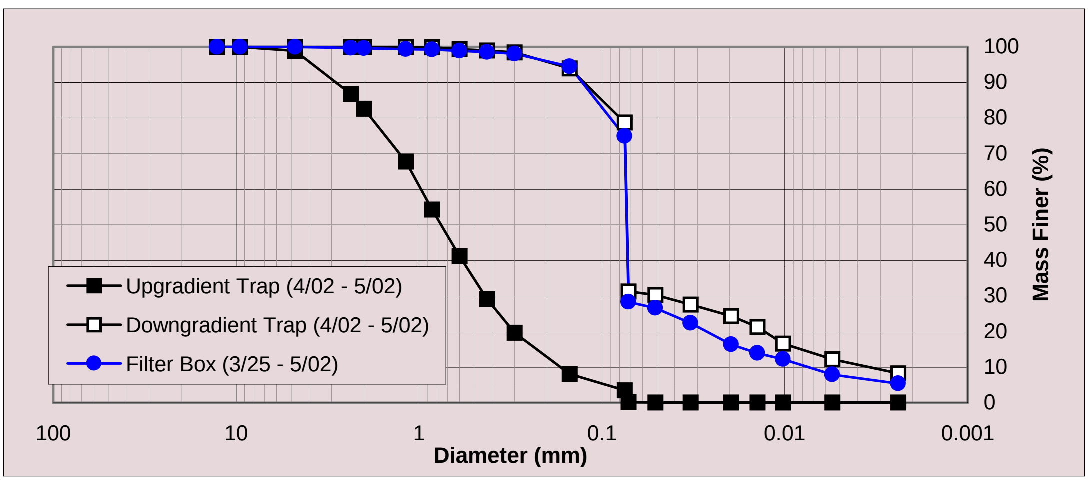


Table 5-6 Monitoring Station 3-202 (Tahoe Airport) - Period 1 - Grain Size Distribution Results

Diameter (mm)	Mass Finer (%)			
	Up-gradient Barrel (12/29 - 4/2)	Down-gradient Barrel (12/29 - 4/2)	Effluent (12/29 - 2/28)	Effluent (2/28 - 4/4)
12.7000	100	100	100	100
9.5250	100	100	100	100
4.7500	98.2	100	99.7	100
2.3600	91.1	100	99.4	99.7
2.0000	89.3	100	99.4	99.5
1.1800	70.7	98.1	98	99
0.8500	62.3	93.7	94.4	98.4
0.6000	51.8	88.2	91.2	97.6
0.4250	42.4	85	89	96.8
0.3000	34.9	82.6	87.4	95.8
0.1500	20.9	78.6	84.8	93.5
0.0750	12.6	73	83.1	90.9
0.0716	2.7	34.2	81.2	62.2
0.0510	2.6	33.3	69.6	59.5
0.0328	2.4	31.6	61.9	50.3
0.0196	2	27.2	52.2	39.7
0.0141	1.8	22.8	44.5	31.9
0.0102	1.5	19.3	33.2	24
0.0055	1.1	12.4	19.9	13.6
0.0024	0.6	7.1	10.1	8.3

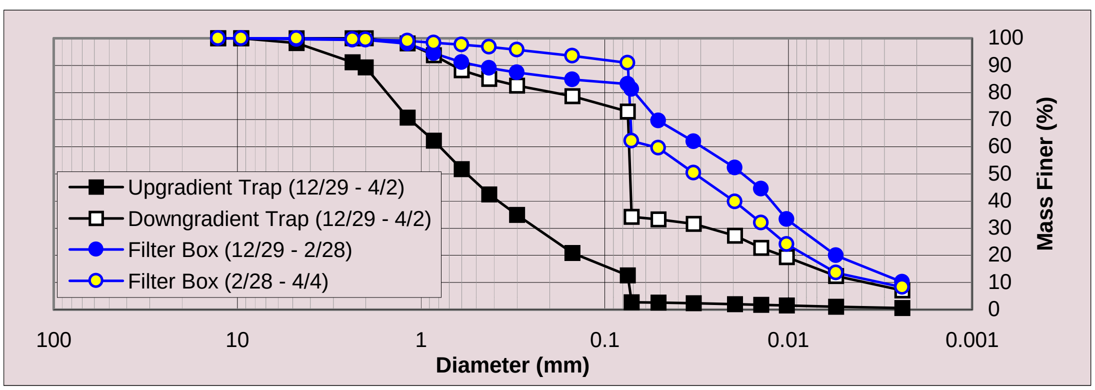


Table 5-7 Monitoring Station 3-202 (Tahoe Airport) - Period 2 - Grain Size Distribution Results

Diameter (mm)	Mass Finer (%)		
	Up-gradient Barrel (4/02 - 5/02)	Down-gradient Barrel (4/02 - 5/02)	Effluent (4/02 - 5/02)
12.7000	100	100	100
9.5250	100	100	100
4.7500	99	99.6	100
2.3600	90.8	98.9	99.7
2.0000	88.1	98.7	99.6
1.1800	75	98.2	98.8
0.8500	61.1	97.7	97.8
0.6000	44.5	96.8	96.7
0.4250	31.5	95.6	95.6
0.3000	21.9	92.8	94.4
0.1500	10.3	87	77
0.0750	5.9	80.2	67.1
0.0716	0.2	43.2	7.2
0.0510	0.2	41.1	6.5
0.0328	0.2	38.9	5.7
0.0196	0.2	35.7	4.9
0.0141	0.2	32.5	4.1
0.0102	0.2	29.3	3.3
0.0055	0.1	18.5	2.5
0.0024	0.1	11.2	1.1

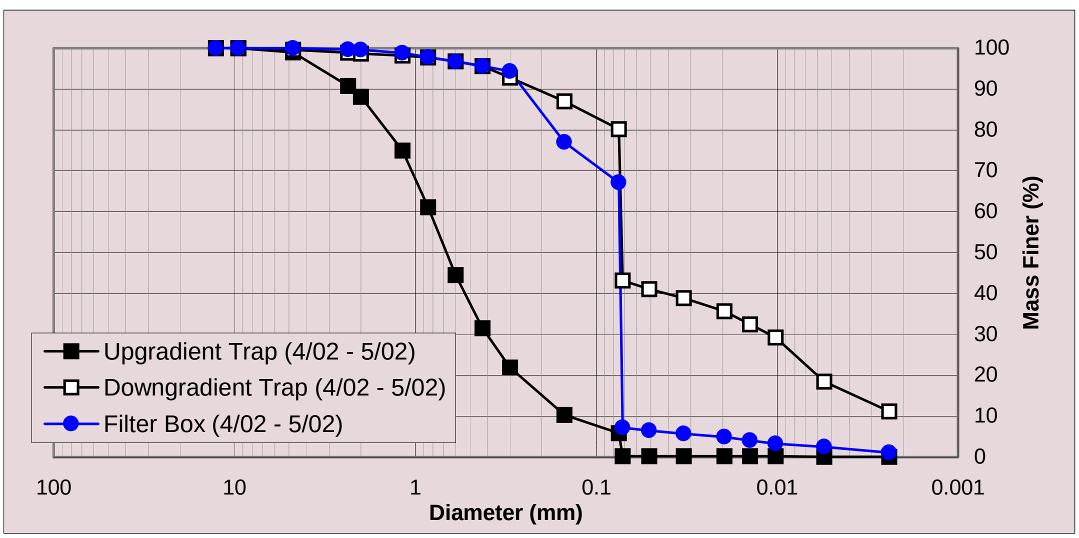
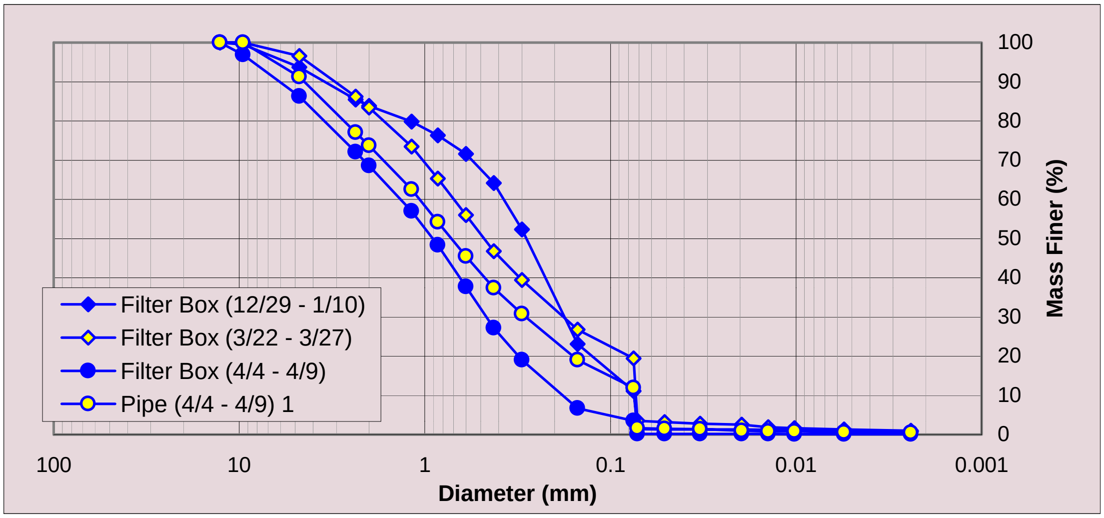


Table 5-8 Monitoring Station 3-07 (Zinfandel Road) – Periods 1-3 - Grain Size Distribution Results

Diameter (mm)	Mass Finer (%)			
	Period 1 Filter Box (12/29 - 1/10)	Period 2 Filter Box (3/22 - 3/27)	Period 3 Filter Box (4/4 - 4/9)	Period 3 Pipe (4/4 - 4/9) [1]
12.7000	100	100	100	100
9.5250	99.5	100	96.9	100
4.7500	93.7	96.6	86.3	91.3
2.3600	85.5	86.2	72.1	77.1
2.0000	83.8	83.4	68.6	73.7
1.1800	79.8	73.5	57	62.5
0.8500	76.3	65.3	48.3	54.2
0.6000	71.6	56	37.7	45.5
0.4250	64.2	46.8	27.2	37.4
0.3000	52.3	39.4	19	30.8
0.1500	23.1	26.8	6.7	19
0.0750	11.1	19.4	3.5	11.9
0.0716	1.4	3.5	0.2	1.6
0.0510	1.3	3.2	0.2	1.5
0.0328	1.3	2.8	0.2	1.4
0.0196	1.3	2.5	0.2	1
0.0141	1.2	1.9	0.2	0.8
0.0102	1.1	1.6	0.1	0.8
0.0055	0.9	1.3	0.1	0.6
0.0024	0.7	1	0.1	0.5

[1] Sediment that accumulated in the pipe entering filter box during Period 3.



Sediment characteristics in terms of particle size were similar at all three monitoring stations as demonstrated by relative closeness of the three lines in the graph at the bottom of Table 5-3. Particle sizes ranged from less 0.002 mm to 9.5 mm with the majority of particles falling in the range from 0.1 to 2 mm.

Particle size distributions from the sediment traps, Tables 5-4 through 5-7, show the up-gradient barrels with highest proportion of the coarser grain sediments and the effluent with the highest proportion of finer grain sediments. Particle size distributions were relatively consistent among the three monitoring periods at the Station 3-07, Zinfandel Road (Table 5-8). Station 3-07 samples included a small amount of large sediments (> 5 mm) that the samples from the Tahoe stations did not.

5.1.3 Sediment Chemical Analysis Results

Samples of the various particle size fractions were composited into five size categories (< 0.02 mm, 0.02 – 0.30 mm, 0.30 – 0.85 mm, 0.85 – 2.00 mm, and > 2.00 mm). Each composite sample was analyzed for the 12 parameters listed in Table 3-2. All the analytical results of presented in Appendix E along with any QA/QC flag assigned to an individual data point.

Tables 5-9 through 5-12 summarize the chemical analyses results obtained for sediment samples collected at the three monitoring stations. Table 5-9 summarizes the chemical analyses results for all samples, while Tables 5-10, 5-11 and 5-12 summarize the results for samples at Monitoring Station 3-203 (Echo Summit), Monitoring Station 3-202 (Tahoe Airport) and Monitoring Station 3-07 (Zinfandel), respectively. The Caltrans data analysis tool (DAT) was applied to generate the statistical values shown in the tables.

The majority of the parameters were detected in the all the size fractions from the samples collected at all three sites. Nitrate/nitrite was the only parameter that had a low percentage of detection, ranging from 0 to 33 percent.

Constituent levels were relatively consistent across all five size fraction categories. There were some variations, but significantly higher concentrations (three times higher or more) were not detected in any single size category for a given constituent.

Constituent levels were comparable amongst the three monitoring stations. All the concentrations were within the same order of magnitude. Variations ranged from zero to 100 percent. Concentrations of individual parameters may be lower at one station, but never whole categories of similar constituents such as all the nutrients or metals.

Table 5-9 Chemical Quality Data Summary – All Sites

Size Fraction (mm)	Statistic	Parameter (mg/kg)				
		TOC	TKN	NO3/ NO2	NO2	P
<0.02	n	10	10	10	10	10
	% Detected	100%	100%	0%	80%	70%
	Min Detected Value	1,600	170	NA	0.06	1.5
	Max Detected Value	15,000	2,400	NA	1.9	20
	Mean	7,380	721	NA	0.35	4.9
	Median	5,600	585	NA	0.09	2.5
	CV	0.75	1.04	NA	2.00	1.42
>0.02 - 0.30	n	10	10	10	10	10
	% Detected	100%	100%	10%	70%	80%
	Min Detected Value	770	80	0.6	0.068	1.2
	Max Detected Value	11,000	2,300	0.6	1.7	15
	Mean	4,497	911	NA	0.32	3.5
	Median	3,100	845	NA	0.12	1.65
	CV	0.79	0.81	NA	1.89	1.46
>0.30 - 0.85	n	10	10	10	10	10
	% Detected	100%	90%	10%	80%	100%
	Min Detected Value	970	310	6.5	0.061	0.6
	Max Detected Value	16,000	3,000	6.5	4.2	7.6
	Mean	5,927	1,000	NA	0.73	3.03
	Median	3,900	850	NA	0.14	2.4
	CV	0.90	0.94	NA	2.12	0.77
>0.85 - 2.00	n	10	10	10	10	10
	% Detected	100%	100%	10%	60%	100%
	Min Detected Value	1,400	250	0.8	0.06	0.71
	Max Detected Value	17,000	2,200	0.8	1.3	16
	Mean	6,360	968	NA	0.25	4.00
	Median	4,250	880	NA	0.1	2.35
	CV	0.88	0.70	NA	1.87	1.33
>2.00	n	10	10	10	10	10
	% Detected	100%	100%	10%	70%	90%
	Min Detected Value	820	130	0.5	0.016	0.92
	Max Detected Value	17,000	3,200	0.5	0.36	6.7
	Mean	5,762	929	NA	0.10	2.70
	Median	3,900	785	NA	0.08	2.05
	CV	0.92	1.09	NA	1.22	0.80

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Table 5-9 Chemical Quality Data Summary – All Sites *(Continued)*

Size Fraction (mm)	Statistic	Parameter (mg/kg) Cd	Cr	Cu	Pb	Ni	Zn	Fe
<0.02	n	10	10	10	10	10	10	10
	% Detected	80%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.503	8.01	16.7	13.8	7.67	77.5	8,730
	Max Detected Value	4.72	56.2	287	87.8	46.5	658	22,100
	Mean	1.80	26.1	88.5	43.0	21.2	302	16,033
	Median	1.37	22.2	63.3	35.8	17.8	249	16,600
	CV	0.88	0.64	1.02	0.65	0.61	0.63	0.29
>0.02 - 0.30	n	10	10	10	10	10	10	10
	% Detected	70%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.07	11.1	13.5	12	8.91	63	9,240
	Max Detected Value	3.63	40.3	230	83.9	33.7	518	18,600
	Mean	1.23	23.0	63.8	31.8	18.8	291	15,164
	Median	0.96	17.5	43.9	22.0	16.1	251	15,900
	CV	1.07	0.52	1.16	0.78	0.48	0.60	0.20
>0.30 - 0.85	n	10	10	10	10	10	10	10
	% Detected	70%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.64	5.35	8.54	7.56	5.16	40.9	5,400
	Max Detected Value	2.57	39	72.8	55	35.7	633	21,200
	Mean	1.21	22.0	41.3	27.9	19.0	269	13,988
	Median	0.90	22.6	45.4	23.9	17.0	200	14,900
	CV	0.71	0.56	0.52	0.59	0.51	0.68	0.36
>0.85 - 2.00	n	10	10	10	10	10	10	10
	% Detected	70%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.57	4.06	7.8	6	4.75	32.8	5,410
	Max Detected Value	2.69	40.5	624	54.1	25.6	4,490	22,000
	Mean	1.34	19.6	94.7	23.8	16.28	723	14,138
	Median	1.12	16.7	45.7	23	15.8	395	14,650
	CV	0.71	0.66	2.72	0.67	0.44	2.47	0.36
>2.00	n	10	10	10	10	10	10	10
	% Detected	60%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.51	5.29	6.1	2.7	7.23	22.2	4,710
	Max Detected Value	2.39	33.3	46.1	48.6	34.9	588	17,300
	Mean	0.99	15.6	26.9	17.0	17.1	212	11,444
	Median	0.68	12.6	25.4	11.1	16.2	148	12,020
	CV	0.86	0.59	0.51	0.90	0.50	0.98	0.45

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Table 5-10 Chemical Quality Data Summary – Monitoring Station 3-203 (Echo Summit)

Size Fraction (mm)	Statistic	Parameter (mg/kg) TOC	TKN	NO3/ NO2	NO2	P
<0.02	n	4	4	4	4	4
	% Detected	100%	100%	0%	100%	50%
	Min Detected Value	1,600	170	NA	0.073	1.5
	Max Detected Value	8,500	940	NA	1.9	2.9
	Mean	5,025	533	NA	0.62	NA
	Median	5,000	510	NA	0.25	NA
	CV	0.62	0.69	NA	1.77	NA
>0.02 - 0.30	n	4	4	4	4	4
	% Detected	100%	100%	0%	100%	75%
	Min Detected Value	770	360	NA	0.068	1.2
	Max Detected Value	11,000	860	NA	0.49	4
	Mean	5,040	610	NA	0.20	1. 9
	Median	4,200	610	NA	0.12	1.6
	CV	1.03	0.45	NA	1.24	0.94
>0.30 - 0.85	n	4	4	4	4	4
	% Detected	100%	100%	25%	100%	100%
	Min Detected Value	970	360	6.5	0.06	0.6
	Max Detected Value	13,000	880	6.5	4.2	3.2
	Mean	6,092.5	620	NA	1.313	1.9
	Median	5,200	620	NA	0.495	1.9
	CV	0.97	0.43	NA	1.86	0.62
>0.85 - 2.00	n	4	4	4	4	4
	% Detected	100%	100%	0%	50%	100%
	Min Detected Value	1,400	350	NA	0.14	0.71
	Max Detected Value	14,000	1,400	NA	0.5	3.1
	Mean	6,880	770	NA	0	2.1
	Median	6,050	665	NA	0	2.2
	CV	0.89	0.67	NA	0	0.54
>2.00	n	4	4	4	4	4
	% Detected	100%	100%	0%	100%	75%
	Min Detected Value	1,900	130	NA	0.079	0.92
	Max Detected Value	11,000	1,400	NA	0.36	4.7
	Mean	5,475	713	NA	0.15	2.34
	Median	4,500	660	NA	0.08	2.21
	CV	0.84	0.82	NA	1.30	1.20

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Table 5-10 Chemical Quality Data Summary – Monitoring Station 3-203 (Echo Summit) *(Continued)*

Size Fraction (mm)	Statistic	Parameter (mg/kg)						
		Cd	Cr	Cu	Pb	Ni	Zn	Fe
<0.02	n	4	4	4	4	4	4	4
	% Detected	50%	100%	100%	100%	100%	100%	100%
	Min Detected Value	2.06	12.1	16.7	13.8	9.29	77.5	10,000
	Max Detected Value	2.66	41.9	287	82	24.4	378	21,400
	Mean	NA	24.1	108	42.4	17.3	222	16,300
	Median	NA	21.2	64	36.8	17.8	217	16,900
	CV	NA	0.63	1.37	0.79	0.40	0.64	0.32
>0.02 - 0.30	n	4	4	4	4	4	4	4
	% Detected	50%	100%	100%	100%	100%	100%	100%
	Min Detected Value	1.13	11.1	13.5	12	8.91	63	9,240
	Max Detected Value	2.15	33.3	48.6	51.7	20.4	373	18,600
	Mean	NA	18.8	28.0	25.8	14.2	179	14,160
	Median	NA	15.4	25	19.8	13.85	139	14,400
	CV	NA	0.64	0.60	0.83	0.38	0.90	0.32
>0.30 - 0.85	n	4	4	4	4	4	4	4
	% Detected	50%	100%	100%	100%	100%	100%	100%
	Min Detected Value	1.69	5.35	8.54	9.94	5.16	40.9	5,400
	Max Detected Value	2.57	39	53.2	55	24	418	21,200
	Mean	NA	20	29.4	28.1	14.9	214	14,225
	Median	NA	17.9	27.9	23.7	15.3	200	15,150
	CV	NA	0.81	0.69	0.808	0.57	0.80	0.52
>0.85 - 2.00	n	4	4	4	4	4	4	4
	% Detected	50%	100%	100%	100%	100%	100%	100%
	Min Detected Value	1.28	4.06	7.78	6	4.75	32.8	5,410
	Max Detected Value	2.69	40.5	55.3	54.1	25.6	422	22,000
	Mean	NA	18.9	30.0	25.3	14.7	194	14,002.5
	Median	NA	15.5	27.6	20.5	14.2	161	14,300
	CV	NA	0.94	0.74	0.94	0.64	0.97	0.54
>2.00	n	4	4	4	4	4	4	4
	% Detected	50%	100%	100%	100%	100%	100%	100%
	Min Detected Value	1.64	5.29	6.13	2.7	8.03	22.2	4,860
	Max Detected Value	2.13	33.3	46.1	48.6	21.4	385	17,300
	Mean	NA	18.8	28.1	24.2	15.7	185	13,365
	Median	NA	18.4	30.1	22.7	16.8	166	15,650
	CV	NA	0.72	0.66	0.89	0.40	0.91	0.54

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Table 5-11 Chemical Quality Data Summary – Monitoring Station 3-202 (Tahoe Airport)

Size Fraction (mm)	Statistic	Parameter (mg/kg)				
		TOC	TKN	NO3/ NO2	NO2	P
<0.02	n	3	3	3	3	3
	% Detected	100%	100%	0%	100%	100%
	Min Detected Value	2,300	460	NA	0.06	2.1
	Max Detected Value	15,000	970	NA	0.57	20
	Mean	7,670	740	NA	0.24	8.8
	Median	5,700	790	NA	0.10	4.3
	CV	1.01	0.40	NA	1.53	1.41
>0.02 - 0.30	n	3	3	3	3	3
	% Detected	100%	100%	33%	67%	100%
	Min Detected Value	2,700	340	0.6	0.26	1.2
	Max Detected Value	6,600	1,100	0.6	0.44	15
	Mean	4,270	797	NA	NA	8.03
	Median	3,500	950	NA	NA	7.9
	CV	0.59	0.62	NA	NA	0.96
>0.30 - 0.85	n	3	3	3	3	3
	% Detected	100%	100%	0%	67%	100%
	Min Detected Value	3,400	310	NA	0.18	2.5
	Max Detected Value	16,000	1,100	NA	0.26	6.4
	Mean	7,930	803	NA	NA	4.00
	Median	4,400	1,000	NA	NA	3
	CV	1.15	0.68	NA	NA	0.68
>0.85 - 2.00	n	3	3	3	3	3
	% Detected	100%	100%	33%	67%	100%
	Min Detected Value	3,900	250	0.8	0.17	0.94
	Max Detected Value	17,000	1,200	0.8	0.27	2.9
	Mean	8,500	817	NA	NA	2.1
	Median	4,600	1,000	NA	NA	2.3
	CV	1.15	0.74	NA	NA	0.57
>2.00	n	3	3	3	3	3
	% Detected	100%	100%	33%	100%	100%
	Min Detected Value	3,700	510	0.5	0.02	2
	Max Detected Value	17,000	3,200	0.5	0.29	4.7
	Mean	8,270	1,500	NA	0.13	2.9
	Median	4,100	800	NA	0.09	2.1
	CV	1.23	1.26	NA	1.28	0.70

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Table 5-11 Chemical Quality Data Summary – Monitoring Station 3-202 (Tahoe Airport) *(Continued)*

Size Fraction (mm)	Statistic	Parameter (mg/kg)						
		Cd	Cr	Cu	Pb	Ni	Zn	Fe
<0.02	n	3	3	3	3	3	3	3
	% Detected	100%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.503	8.01	32.6	19	7.67	187	8,730
	Max Detected Value	1.07	17.1	45	26	15.5	536	19,100
	Mean	0.82	12.9	36.8	21.4	11.6	311	14,480
	Median	0.88	13.5	32.8	19.2	11.5	210	15,600
	CV	0.40	0.40	0.26	0.25	0.378	0.82	0.42
>0.02 - 0.30	n	3	3	3	3	3	3	3
	% Detected	67%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.787	12.8	25.5	13.7	10.7	175	14,300
	Max Detected Value	2.34	16	50.1	28.2	16.2	518	17,800
	Mean	NA	14.9	38.2	20.8	14.0	394	16,100
	Median	NA	15.9	39.1	20.4	15.2	490	16,100
	CV	NA	0.16	0.36	0.39	0.26	0.63	0.124
>0.30 - 0.85	n	3	3	3	3	3	3	3
	% Detected	67%	100%	100%	100%	100%	100%	100%
	Min Detected Value	1.02	7.69	14.8	7.56	7.25	104	8,580
	Max Detected Value	2.19	18.7	49.3	24	17.8	633	20,900
	Mean	NA	14.4	35.2	17.9	13.6	382	14,860
	Median	NA	16.7	41.4	22.2	15.7	408	15,100
	CV	NA	0.50	0.62	0.64	0.50	0.78	0.46
>0.85 - 2.00	n	3	3	3	3	3	3	3
	% Detected	67%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.965	5.43	13.7	6.06	6.79	90.5	7,770
	Max Detected Value	2.34	17	46.6	24.1	17.2	646	19,000
	Mean	NA	12.8	35.4	17.4	13.2	386	14,390
	Median	NA	15.9	46	21.9	15.7	422	16,400
	CV	NA	0.65	0.72	0.72	0.53	0.81	0.495
>2.00	n	3	3	3	3	3	3	3
	% Detected	67%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.84	7.28	16.4	7.96	7.23	162	8,480
	Max Detected Value	2.49	16.6	43.6	21.6	16.1	588	17,000
	Mean	NA	12.5	32.8	17.0	13.0	411	13,460
	Median	NA	13.5	38.4	21.3	15.7	482	14,900
	CV	NA	0.44	0.54	0.62	0.51	0.64	0.39

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Table 5-12 Chemical Quality Data Summary – Monitoring Station 3-07 (Zinfandel Road)

Size Fraction (mm)	Statistic	Parameter (mg/kg)				
		TOC	TKN	NO3/ NO2	NO2	P
<0.02	n	3	3	3	3	3
	% Detected	100%	100%	0%	33%	67%
	Min Detected Value	1,700	180	NA	0.27	2.9
	Max Detected Value	15,000	2,400	NA	0.27	12
	Mean	10,200	953	NA	0	0
	Median	14,000	280	NA	0	0
	CV	0.95	1.75	NA	0	0
>0.02 - 0.30	n	3	3	3	3	3
	% Detected	100%	100%	0%	33%	67%
	Min Detected Value	1,900	80	NA	1.7	1.6
	Max Detected Value	8,000	2,300	NA	1.7	1.7
	Mean	4,000	1,430	NA	NA	NA
	Median	2,100	1,900	NA	NA	NA
	CV	1.16	1.03	NA	NA	NA
>0.30 - 0.85	n	3	3	3	3	3
	% Detected	100%	67%	0%	67%	100%
	Min Detected Value	1,800	2,000	NA	0.061	1.2
	Max Detected Value	7,300	3,000	NA	1.5	7.6
	Mean	3,700	NA	NA	NA	3.6
	Median	2,000	NA	NA	NA	2
	CV	1.13	NA	NA	NA	1.23
>0.85 - 2.00	n	3	3	3	3	3
	% Detected	100%	100%	0%	67%	100%
	Min Detected Value	1,700	250	NA	0.06	2.2
	Max Detected Value	6,800	2,200	NA	1.3	16
	Mean	3,530	1,380	NA	NA	8.53
	Median	2,100	1,700	NA	NA	7.4
	CV	1.05	0.85	NA	NA	0.93
>2.00	n	3	3	3	N/A	3
	% Detected	100%	100%	0%	N/A	100%
	Min Detected Value	820	160	NA	N/A	1
	Max Detected Value	6,600	960	NA	N/A	6.7
	Mean	3,640	643	NA	N/A	NA
	Median	3,500	810	NA	N/A	NA
	CV	0.89	0.81	NA	N/A	NA

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Table 5-12 Chemical Quality Data Summary – Monitoring Station 3-07 (Zinfandel Road) *(Continued)*

Size Fraction (mm)	Statistic	Parameter (mg/kg)						
		Cd	Cr	Cu	Pb	Ni	Zn	Fe
<0.02	n	3	3	3	3	3	3	3
	% Detected	100%	100%	100%	100%	100%	100%	100%
	Min Detected Value	1.66	27.2	81.5	45.6	25.2	181	12,200
	Max Detected Value	4.72	56.2	169	87.8	46.5	658	22,100
	Mean	3.44	42.2	114	65.5	36.1	399	17,200
	Median	3.93	43.1	92.8	63.2	36.5	357	17,400
	CV	0.55	0.38	0.53	0.36	0.33	0.69	0.32
>0.02 - 0.30	n	3	3	3	3	3	3	3
	% Detected	100%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.07	29.5	88.2	16.9	21.9	178	14,900
	Max Detected Value	3.63	40.3	230	83.9	33.7	506	16,200
	Mean	1.83	NA	137.1	50.9	29.7	336	15,600
	Median	1.78	NA	93.1	51.8	33.5	324	15,700
	CV	1.09	NA	0.79	0.739	0.314	0.55	0.05
>0.30 - 0.85	n	3	3	3	3	3	3	3
	% Detected	100%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.644	28.4	53.7	23.8	24	184	10,700
	Max Detected Value	2.1	35.4	72.8	46.8	35.7	315	15,000
	Mean	1.17	32.2	63.4	37.8	29.8	228	12,800
	Median	0.786	32.8	63.7	42.8	29.8	185	12,700
	CV	0.88	0.12	0.17	0.40	0.22	0.45	0.19
>0.85 - 2.00	n	3	3	3	3	3	3	3
	% Detected	100%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.57	16.4	45.3	16.5	15.8	368	12,900
	Max Detected Value	2.16	39.2	624	41.8	24.1	4,490	15,500
	Mean	1.63	27.3	240.9	28.2	21.3	1,764	14,100
	Median	2.15	26.3	53.4	26.4	23.9	434	13,800
	CV	0.76	0.47	1.87	0.51	0.30	1.81	0.11
>2.00	n	3	3	3	3	3	3	3
	% Detected	67%	100%	100%	100%	100%	100%	100%
	Min Detected Value	0.51	10.1	11.2	4.11	11.1	25.9	4,710
	Max Detected Value	1.25	20.8	24	9.96	34.9	70.1	9,140
	Mean	NA	14.2	19.3	7.35	23.1	49.9	6,870
	Median	NA	11.7	22.8	7.99	23.3	53.6	6,750
	CV	NA	0.51	0.47	0.46	0.57	0.51	0.36

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

5.2 Autosampler Effectiveness Results

Autosampler effectiveness was characterized in the comparison of sediments collected by the autosampler versus the sediments collected in the sample of the entire flow stream. The comparison was made in terms of mass (gravimetric) and particle size distribution. The method applied to collect the samples is discussed in Section 3.5.

Table 5-13 summarizes the samples collected for the autosampler effectiveness study and the analyses conducted on these samples. The table lists samples that were collected and the analyses performed for both the test sites and the specific monitoring stations.

Table 5-13 Autosampler Effectiveness Sample Collection and Analysis Summary

Location	Samples	Collection Date	Analyses [1]		
			Gravimetric [2]	Grain Size [3]	Particle Count [4]
Station 3-203 HY 50 near Echo Summit	Grab – manual [5] Autosampler [6]	3/14/01	X	X	X
	Grab – manual [5] Autosampler [6]	4/10/01	X	–	–
	Grab – manual [5] Autosampler [6]	4/20/01	X	–	–
Station 3-07 HY 50 at Zinfandel	Grab – manual [5] Autosampler [6]	2/19/01	X	–	–
	Grab – manual [5] Autosampler [6]	2/24/01	X	–	–
	Grab – manual [5] Autosampler [6]	3/4/01	X	–	–
	Grab – manual [5] Autosampler [6]	4/20/01	X	–	–

Notes:
[1] "X" = Analyzed and "–" = Not analyzed.

[2] Gravimetric analyses conducted at CDM Laboratory, Denver CO.

[3] Grain size distribution analyses (ASTM D422) conducted by Goodsen and Associates, Denver CO.

[4] Particle count analyses conducted using Standard Methods for the Examination of Water and Waste Water, 10200 E (Microscopes and Calibrations) and 10200F (Phytoplankton Counting Techniques).

[5] Grab sample of known volume collected of the entire flow stream using a bucket during the same period as the autosampler sample is collected.

[6] Sample of known volume collected by the autosampler during the same period as the manual sample is collected.

The sampling procedures and equipment were developed for the Tahoe Basin study. Both the procedures and equipment provided the means to collect the desired samples. However, collecting the required mass to perform all the analyses proved to be a problem. The low solids content required that large volumes of runoff be collected. This posed logistical problems for handling large volumes of runoff. Special equipment designed to transport and filter large liquid volumes would facilitate the process and improve the sampling success.

5.2.1 Gravimetric Results

Appendix C provides a detailed listing of the gravimetric measurement results for the autosampler effectiveness study. The results represent dry weight of the material collected by the manual grab method and the autosampler. Table 5-14 summarizes the gravimetric analyses results obtained for the sediment samples collected by the water volume system and autosampler. Evaluation of these results will be discussed in Section 6.3 of this report.

Table 5-14 Summary of Gravimetric Analyses for Autosampler Effectiveness Study

Location	Samples	Date Sampled	Period	Mass (g)
Monitoring Station 3-203 Echo Summit	Autosampler	3/14/01	Period 1	391.2
	Manual Bucket	3/14/01	Period 1	98.1
	Autosampler	4/10/01	Period 2	22.73
	Manual Bucket	4/10/01	Period 2	26.69
	Autosampler	4/20/01	Period 3	1.56
	Manual Bucket	4/20/01	Period 3	1.37
Monitoring Station 3-07 Zinfandel Road	Autosampler	2/19/01	Period 1	0.62
	Manual Bucket	2/19/01	Period 1	3.48
	Autosampler	2/24/01	Period 2	0.39
	Manual Bucket	2/24/01	Period 2	0.98
	Autosampler	3/4/01	Period 3	1.96
	Manual Bucket	3/4/01	Period 3	1.53
	Manual Bucket	4/20/01	Period 4	1.46
	Autosampler	4/20/01	Period 4	1.29

5.2.2 Particle Size Distribution Results

Due to insufficient sample mass, particle size analyses by ASTM D422 could not be conducted on sediments collected during the filtration process of autosampler and manual grab samples. Instead, selected autosampler and manual grab samples were analyzed for particle size distribution using an alternative particle counting method. In order to evaluate this alternative method for possible future investigations, selected samples from the sediment characterization study were analyzed by both the ASTM and counting methods.

Table 5-15 summarizes the results obtained for the particle counting method. The size fraction categories were not always consistent among all the tests. Therefore, the table lists both the size fraction distribution and the percentage of total sediment found within each size range for each individual test result. The number a particles counted is also provided. Evaluation of these results will be discussed in Section 6.3.

Table 5-15 Summary of Particle Counting Data

Sediment Characterization Study							
Monitoring Station 3-202 (Tahoe Airport)				**Monitoring Station 3-07 (Zinfandel Road)**		**Monitoring Station 3-203 (Echo Summit)**	
Particle Size (mm)	**Effluent (2/28 - 4/4)**	**Particle Size (mm)**	**Effluent (12/29 - 2/28)**	**Particle Size (mm)**	**Effluent (3/22 - 3/27)**	**Particle Size (mm)**	**Effluent (2/28 - 3/25)**
5	5 %	5 - 9	1 %	10 - 30	18 %	7 - 10	4 %
0.009 - 0.0012	0 %	0.009 - 0.0012	0 %	0.009 - 0.0012	0 %	0.009 - 0.0012	0 %
0.006	1 %	0.006 - 0.009	1 %	0.006 - 0.009	1 %	0.006 - 0.009	0 %
0.003 - 0.006	7 %	0.004 - 0.006	0 %	0.004 - 0.006	2 %	0.003 - 0.006	3 %
<0.003	87 %	0.003	9 %	0.003	37 %	0.001 - 0.003	93 %
		<0.002	91 %	<0.003	42 %		
Particle Count/gram	93,600,000	Particle Count/gram	260,000,000	Particle Count/gram	44,200,000	Particle Count/gram	251,000,000

Autosampler Effectiveness Study							
Monitoring Station 3-203 (Echo Summit)							
Particle Size (mm)	**Manual Test 1 (3/14)**	**Particle Size (mm)**	**Manual Test 2 (3/14)**	**Particle Size (mm)**	**Autosampler Test1 (3/14)**	**Particle Size (mm)**	**Autosampler Test 2 (3/14)**
1 - 4	2 %	5	5 %	2 - 5	7 %	1 - 3	5 %
0.009 - 0.0012	0 %	0.009 - 0.0012	0 %	0.009 - 0.0012	1 %	0.009 - 0.0012	0 %
0.006 - 0.009	1 %	0.006 - 0.009	0 %	0.006 - 0.009	1 %	0.006 - 0.009	0 %
0.003 - 0.006	2 %	0.003 - 0.006	0 %	0.003 - 0.006	1 %	0.004 - 0.006	1 %
0.001 - 0.002	10 %	<0.003	95 %	<0.002	90 %	0.003	5 %
<0.001	85 %					<0.002	89 %
Particle Count/gram	382,000,000	Particle Count/gram	134,000,000	Particle Count/gram	47,000,000	Particle Count/gram	30,000,000

Section 6
Data Evaluation

6.1 Runoff Water Quality

One of the primary goals of the Tahoe Basin Stormwater Monitoring Study was to characterize water quality of the runoff from Caltrans roadway facilities in the Tahoe Basin. The characterization will be based on defining the concentrations of various chemical parameters of interest (as shown in Table 4.2) and how these data:

- Compare to runoff quality data from other Caltrans highway sites included in the Statewide Monitoring Study;
- Compare to limits established for stormwater discharges to surface waters in the Tahoe Basin;
- Compare to precipitation quality data collected at the monitoring stations;
- Are impacted by changes in the season, such as summer, fall/spring, and winter;
- Are impacted by elevation, such as at lake level versus high elevation; and
- Are impacted by land use, such as an urban setting versus a rural setting.

6.1.1 Comparison to Statewide Monitoring Study Data

The quality of stormwater runoff was monitored at 29 highway sites during the 2000/2001 wet season throughout California as part of the Caltrans Statewide Stormwater Runoff Characterization Study. Results of the runoff quality data collected at the 29 highway sites are compared to the water quality results from the Tahoe Basin Study in Table 6-1. The water quality samples in the Statewide Study were not analyzed for turbidity, chloride, oil and grease, and iron (total and dissolved).

There are some obvious differences between the values from the Tahoe Basin Study and the values from the Statewide Study as shown in Table 6-1. The mean and median values for most of the conventional parameters and total metals are higher from the Tahoe Basin. The greatest differences are between mean and median values for electrical conductivity (EC), total suspended solids (TSS), total dissolved solids (TDS), and all the total metals. These differences are probably due to the application of both sand and salt to the roadways in the Tahoe Basin during snow management activities. Sand and salt included in the runoff will increase levels of EC, TSS, TDS, and possibly total metals.

Table 6-1 Comparison Runoff Water Quality Data to Statewide Monitoring Water Quality

		Tahoe Basin Study					Statewide Highway Runoff [1]				
Consituent / Parameter	**Units**	**Range**		**Mean [2]**	**Median**	**CV**	**Range**		**Mean**	**Median**	**CV**
		Min	**Max**				**Min**	**Max**			
Conventionals											
pH	pH units	5.6	8.5	**7.3**	7.3	0.11	5.1	10.1	7.2	7.2	0.11
EC	umhos/cm	39	16200	**2400**	1026	1.68	7	1285	96	65	1.28
TSS	mg/L	25	5100	**989**	608	1.35	2	1373	94	55	1.75
TDS	mg/L	27	8780	**1854**	898	1.31	5	724	85	57	1.12
Hardness as CaCO3	mg/L	6	412	**94**	74	1.03	3	400	37	26	1.12
DOC	mg/L	4	65	**22**	17	0.72	1.3	155	15	9.8	1.20
TOC	mg/L	4	81	**25**	21	0.74	1.4	137	18	13	1.03
Turbidity	NTUs	8	2620	575	493	1.12					
Chloride	mg/L	3	5300	1069	510	1.36					
Oil & grease	mg/L	5	7	4	NA	NA					
Nutrients											
Nitrate (as N)	mg/L	0.1	1.0	0.4	0.3	0.61	0.1	48	1.2	NA	3.46
TKN	mg/L	0.3	5.6	1.6	0.8	0.99	0.1	14.5	1.8	1.4	0.99
Total Phosphorus	mg/L	0.08	9.90	**1.30**	0.55	1.90	0.03	4.69	0.3	NA	1.81
Diss. Orthophosphate	mg/L	0.03	0.38	0.11	0.10	0.78	0.04	2.3	0.18	NA	1.32
Total Metals											
Arsenic	ug/L	0.7	25.5	**6.1**	5.5	0.94	0.5	9	1	NA	0.87
Cadmium	ug/L	0.3	3.0	**1.0**	0.9	0.72	0.2	5	0.6	NA	0.89
Chromium	ug/L	4	120	**28**	24	0.98	1	98	8	5	1.56
Copper	ug/L	16	170	**55**	44	0.64	1.2	230	22	17	1.19
Iron	ug/L	1540	162000	32802	22000	1.25					
Lead	ug/L	5	367	**66**	51	1.30	1	327	22	6	2.03
Nickel	ug/L	4	67	**19**	15	0.77	2	208	11	7	1.84
Zinc	ug/L	39	1030	**359**	289	0.66	8	1245	130	81	1.28
Dissolved Metals											
Arsenic	ug/L	0.6	20.1	**2.6**	1.3	1.97	0.6	4.8	0.9	0.8	0.69
Cadmium	ug/L	0.2	0.27	NA	NA	NA	0.2	4.7	0.4	0.4	0.95
Chromium	ug/L	1	12	**4**	4	0.64	1	19	3	2	1.22
Copper	ug/L	3	42	**13**	10	0.76	1.1	121	11	9	1.08
Iron	ug/L	41	8970	832	334	3.09					
Lead	ug/L	1	11	2	1	1.66	1	143	3	1	4.04
Nickel	ug/L	2	14	**4**	3	0.90	1	52	4	3	1.28
Zinc	ug/L	9	283	**56**	32	1.21	3	1017	59	28	2.04

[1] From Table 3-1 of Caltrans Statewide Stormwater Runoff Characterization Study Monitoring Season 2000-2001 Report (July 2001).

[2] Bold Items indicate higher mean values for Tahoe Basin sites than the Statewide Highway Runoff mean value.

CV = Coefficient of Variation

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

The mean and median values for the nutrients were comparable between the two studies as shown in Table 6-1. The Statewide nutrient levels were slightly higher for nitrate, total Kjeldahl nitrogen (TKN), and dissolved orthophosphate. The mean value for total phosphorus from the Tahoe Basin was higher than the value from the Statewide Study. The mean and median values for the dissolved metals were mixed with some being comparable and others being higher from one study or the other.

The range of minimum and maximum values shown in Table 6-1 from the Tahoe Basin Study fell within the range of min/max values from the Statewide Study for the majority of the parameters. The parameters that show a wider range in the Tahoe

Basin included conductivity, TSS, TDS, arsenic (total and dissolved), and total chromium.

The water quality data generated from the summer thunderstorm season provides examples of runoff quality without the impact of the sand and salt. The data collected during two storm events that occurred in August 2000 shows lower concentrations of the above-mentioned parameters. Refer to Table 6-2 for a summary. During these events, the roads had not been sanded or salted since spring and the levels for conductivity, TSS, TDS, and all total metals except copper were lower. The concentrations during these two events were also more in line with the quality found in the Statewide Study.

6-2 Comparison of Runoff Quality from Summer Thunderstorms

Constituent / Parameter	Units	Summer Thunderstorms [1]			Monitoring Season Mean Values	
		Station 3-202 8/03/00	Station 3-203 8/03/00	Station 3-203 8/30/00	Tahoe [1]	Statewide [2]
Conventionals						
pH	pH units	6.6	6.34	5.6	**7.3**	7.2
EC	umhos/cm	39	55	**169**	**2400**	96
TSS	mg/L	48	**263**	25	**989**	94
TDS	mg/L	27	43	**220**	**1854**	85
Hardness as CaCO3	mg/L	12	6	20	**94**	37
DOC	mg/L	11	**19**	**65**	**22**	15
TOC	mg/L	13	**22**	**81**	**25**	18
Turbidity	NTUs	39	138	66	575	N/A
Chloride	mg/L	1	2.8	16	1069	N/A
Oil & grease	mg/L	5	5	7	4	N/A
Nutrients						
Nitrate (as N)	mg/L	0.4	0.66	1	0.4	1.2
TKN	mg/L	**2.5**	**4.8**	**4.8**	1.6	1.8
Total Phosphorus	mg/L	0.17	**0.39**	**0.54**	**1.30**	0.3
Diss. Orthophosphate	mg/L	0.11	0.16	**0.38**	0.11	0.18
Total Metals						
Arsenic	ug/L	0.5	**1.8**	**2.2**	**6.1**	1
Cadmium	ug/L	0.2	**0.8**	0.3	**1.0**	0.7
Chromium	ug/L	4	**13**	**15**	**28**	8
Copper	ug/L	**30**	**34**	**66**	**55**	22
Iron	ug/L	1540	7290	2070	32802	N/A
Lead	ug/L	4	10	14	**66**	22
Nickel	ug/L	5	**35**	**43**	**19**	11
Zinc	ug/L	39	103	**198**	**359**	130
Dissolved Metals						
Arsenic	ug/L	0.5	**2.2**	0.5	**2.6**	0.9
Cadmium	ug/L	0.2	0.3	0.3	NA	0.4
Chromium	ug/L	**3**	**6**	1	**4**	2.6
Copper	ug/L	6	**42**	7	**13**	11
Iron	ug/L	114	497		832	N/A
Lead	ug/L	2	**10.2**	3	2	3.2
Nickel	ug/L	1	**7**	1	**4**	4.4
Zinc	ug/L	9	**165**	**83**	56	59

[1] Bold Items indicate higher mean values for Tahoe Basin sites than the Statewide Highway Runoff mean value.

[2] From Table 3-1 of Caltrans Statewide Stormwater Runoff Characterization Study Monitoring Season 2000-2001 Report (July 2001).

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

N/A Not Analyzed.

6.1.2 Comparison to Tahoe Basin Water Quality Limits

The State of California Regional Water Quality Control Board has established water quality limits for all stormwater discharges to surface waters and infiltration systems in the Tahoe Basin. These limits are published in the Water Control Plan for the Lahoton Region North and South Basins. Surface water runoff, which directly enters Lake Tahoe or a tributary, is required to meet the maximum levels shown in the column entitled "Surface Discharges" in Table 6-3. Surface water runoff, which is directed to infiltrate into the soil, is required to meet the maximum levels shown in the column entitled "Infiltration Systems" in Table 6-3.

Table 6-3 Comparison of Untreated Highway Runoff Quality to Tahoe Stormwater Effluent Limits

		Untreated Tahoe Basin Highway Runoff Quality				Tahoe Stormwater Limits	
Constituent / Parameter	Units	Range		Mean	Median	Surface Discharges	Infiltration Systems
		Min	Max				
Turbidity	NTUs	8	2620	575	493	20	200
Oil & grease	mg/L	5	7	4	NA	2	40
Nitrate (as N)	mg/L	0.1	1.0	0.4	0.3	0.5	5
TKN	mg/L	0.3	5.6	1.6	0.8		
Total Phosphorus	mg/L	0.08	9.90	1.30	0.55	0.1	1
Total Iron	ug/L	1540	162000	32802	22000	500	4000

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

A comparison of the stormwater limits to the summary data from the Caltrans Tahoe Basin Monitoring Study is presented in Table 6-3. The table reveals the mean runoff concentrations from all three stations combined were higher than the surface discharge limits. For comparison, TKN plus nitrate is equivalent to total nitrogen. Mean and median values of the runoff samples ranged from two to sixty-five times higher than the limits. Minimum values were lower than the limits for all parameters except total iron indicating one or two samples had concentrations that were below the limits.

A comparison of the infiltration system limits to the summary data in Table 6-3 indicates the runoff concentrations are often below the limits for total nitrogen and total phosphorus. Both the mean and median values for TKN plus nitrate were below the 5 mg/L limit for total nitrogen, assuming that nitrite concentration is insignificant, and the median value for total phosphorus was below the 1 mg/L limit. The mean total phosphorus value of 1.3 mg/L was 30% above the limit. The mean and median values for turbidity and total iron were still above their respective limits.

The samples collected during the Tahoe Basin Study represented untreated runoff. At all locations, the runoff received treatment after the samples were collected and prior to being discharged to Lake Tahoe or its tributaries. Runoff from the Tahoe Meadows site is treated in the Ski Run wetland treatment facility prior to discharge to Lake Tahoe. Runoff from the Tahoe Airport and Echo Summit sites are treated first in a double barrel sediment trap and the effluent is then allowed to infiltrate into the soil. Post treatment effluents prior to discharge to the lake or infiltration were not monitored. This aspect of the study is planned to be investigated as part of the Tahoe Basin BMP Studies.

6.1.3 Comparison to Precipitation Quality

Precipitation quality samples were collected to determine if precipitation was a source of contamination in the stormwater runoff from the Caltrans highway systems. Table 6-4 compares the runoff data to precipitation data. Comparing the mean values indicates concentrations of contaminants in the precipitation are considerably lower for the majority of the parameters when compared to the mean and median values of the runoff quality. The concentrations in the precipitation for a majority of the parameters were near or below the reporting limits. Only the concentrations for nitrogen, copper, iron and zinc were consistently above reporting limits. The levels for zinc in the precipitation samples were comparable to the levels found in the runoff. Based on the limited data, precipitation does not appear to contribute to contaminants observed in the runoff from Caltrans roadways in the Tahoe Basin.

Table 6-4 Comparison Runoff Water Quality Data to Precipitation Quality

Cpnstituent / Parameter	Units	Mean Stormwater Runoff	Mean Precipitation	Ratio of Precipitation to Runoff
Conventionals				
pH	pH units	7.3	6.1	84%
EC	umhos/cm	2400	50	2%
TSS	mg/L	989	9	1%
TDS	mg/L	1854	29	2%
Hardness as CaCO3	mg/L	94	7	7%
DOC	mg/L	22	2	9%
TOC	mg/L	25	2	8%
Turbidity	NTUs	575	7	1%
Chloride	mg/L	1069	9	1%
Oil & grease	mg/L	NA		
Nutrients				
Nitrate (as N)	mg/L	0.4	0.2	50%
TKN	mg/L	1.6	0.3	19%
Total Phosphorus	mg/L	1.30	0.06	5%
Diss. Orthophosphate	mg/L	0.11	0	0
Total Metals				
Arsenic	ug/L	6.1	0.8	13%
Cadmium	ug/L	1.0	0.1	10%
Chromium	ug/L	28	6.0	21%
Copper	ug/L	55	7.0	13%
Iron	ug/L	32802	1151	4%
Lead	ug/L	66	2.0	3%
Nickel	ug/L	19	3.0	16%
Zinc	ug/L	359	92.0	26%
Dissolved Metals				
Arsenic	ug/L	2.6	0	0
Cadmium	ug/L	NA	0	
Chromium	ug/L	4	0.6	15%
Copper	ug/L	13	3.0	23%
Iron	ug/L	832	38	5%
Lead	ug/L	2	0	0
Nickel	ug/L	4	0	0
Zinc	ug/L	56	52.0	93%

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

6.1.4 Seasonal Impacts

Seasonal differences in the runoff quality were evaluated by first categorizing each monitored runoff event by the type of precipitation that occurs throughout a given year and then comparing runoff quality between the different seasonal categories. Refer to Table 4-3 for a summary of event types and the distribution of monitored events within each category. Summary statistics for each season (summer thunderstorm, rain / snow mix, and snowmelt) are presented in Table 6-5. For individual event data at a specific station, refer to the tables in Appendix B.

Table 6-5 Seasonal Comparison of Mean Values for Different Runoff

Constituent / Parameter	Units	Summer Thunderstorms	Rain / Snow Mix	Snowmelt
Conventionals				
pH	pH units	6	8	7
EC	umhos/cm	88	1275	3634
TSS	mg/L	112	542	1469
TDS	mg/L	97	689	2974
Hardness as CaCO3	mg/L	13	58	135
DOC	mg/L	31	20	21
TOC	mg/L	38	23	23
Turbidity	NTUs	81	468	734
Chloride	mg/L	NA	376	1682
Oil & grease	mg/L	4	NA	NA
Nutrients				
Nitrate (as N)	mg/L	0.69	0.26	0.35
TKN	mg/L	NA	1.04	1.37
Total Phosphorus	mg/L	0.37	1.16	1.61
Diss. Orthophosphate	mg/L	0.22	0.11	0.09
Total Metals				
Arsenic	ug/L	NA	4.8	8.02
Cadmium	ug/L	NA	0.9	1.16
Chromium	ug/L	10.8	16.1	40.2
Copper	ug/L	43.2	38.5	67.1
Iron	ug/L	3633	12905	51609
Lead	ug/L	9.0	12.5	25.4
Nickel	ug/L	27.6	34.0	94.5
Zinc	ug/L	113	259	479
Dissolved Metals				
Arsenic	ug/L	NA	2.6	3.3
Cadmium	ug/L	NA	NA	NA
Chromium	ug/L	3.7	5.0	5.3
Copper	ug/L	18.9	13.5	11.4
Iron	ug/L	263	324	1263
Lead	ug/L	NA	2.9	5.4
Nickel	ug/L	NA	1.0	2.6
Zinc	ug/L	62	51	57

NA = Not Available (Statistics are not calculated for data sets with a high number of non-detects.)

Differences can be observed in the runoff quality on a seasonal basis as shown in Table 6-5. For example, the lowest concentrations of the monitoring season occurred for the conventional parameters and total phosphorous during the summer thunderstorm events. Conversely, the concentrations of nitrate and TKN were some of the highest of the season during these same events. Concentrations of metals from the thunderstorm events were relatively low at Station 3-202, Tahoe Airport, but this trend was not as obvious in the metals data from Station 3-203, Echo Summit.

The data generated at the Echo Summit station during rain/snow mixed events had concentrations of the conventional parameters that were higher than concentrations from the summer thunderstorm events, but the concentrations of nutrients and metals species were lower. The mixed storm events at Station 3-201, Tahoe Meadows, was the first monitored event of the season and the concentrations were low relative to data collected at this site later in the season. The Caltrans highway maintenance logbooks indicated sand and salt were applied to the roadways prior to and during each monitored event in October 2000. This explains the higher concentrations, especially for conductivity, hardness, TSS, TDS, and chloride.

The results of sampling performed during the winter snowmelt period showed increased concentrations or levels in the majority of parameters at all three monitoring stations. This increase can be directly correlated to the increase in snow management activities conducted by Caltrans. Sand and salt were applied during storm events that occurred from October 2000 to April 2001. Up to 85 percent of the season's total of sand and salt was applied along Highway 50 in the California portion of the Tahoe Basin (Echo Summit to the Stateline) during the three-month period between January and March 2001.

The seasonal trends in the data collected during April 2001 events differed amongst the three stations. These differences may be due to differences in the weather conditions. The snow had melted and the ground thawed at lake level where the Tahoe Meadows and Tahoe Airport sites were located. Conversely, winter conditions were still prevalent at the Echo Summit station. Snow management was conducted by Caltrans on all portions of Highway 50 in the Tahoe Basin for each event that was monitored in April 2001.

At the Tahoe Meadows site, levels of all parameters were generally lower for the spring rain/snow mixed events than the levels found during the winter snowmelt monitoring, but not as low as levels found during the October 2000 mixed event. A similar trend but not as pronounced is shown in the April 2001 data from the Tahoe Airport site. But samples collected during an April 11-12, 2001 event found very high levels of chlorides, conductivity and TDS that matched or exceeded winter levels. At the Echo Summit site, concentrations and levels during April 2001 were the highest of the year for many of the conventional parameters and metals, especially the results from the April 11-12, 2001 event.

6.1.5 Elevation Impacts

Very little data were available to evaluate the impact that elevation had on runoff quality. The sand and salt applied to manage the snow and ice on roadways appear to be the dominant factors controlling runoff quality. Once snow management activities start for the season, the other factors that may exert an influence on water quality cannot be deciphered.

Concentrations of constituents from a sample collected at the Echo Summit station during the August 3, 2000 summer thunderstorm were 20 to 500 percent higher than the results of a sample collected at the Tahoe Airport site during the same event. This was the only monitored runoff event without the influence of snow management activities.

Elevation may impact runoff quality through its impact on the weather. Weather conditions directly affect the degree of snow management activities in the Tahoe Basin and the amount of sand and salt that is distributed. At the higher elevations, the orographic effects cause higher amounts of precipitation to be produced. Temperatures are also colder at higher elevations, which extend the winter season and increases the severity of snow or freezing rain events. Section 4.1 discussed these differences in snow accumulation and length of the winter season at various elevations. Based on the 2000-20001 Caltrans maintenance logs, 3 times more sand and 1.2 times more salt were applied along the stretch of Highway 50 from Echo Summit to the Meyers (mile markers 66.6 to 70.4) than on the other portions of Highway 50 located in the Tahoe Basin. This stretch has the highest average elevation along Highway 50 in the Basin. This additional material is reflected in the higher levels of EC, TSS, and TDS found in the runoff quality from monitoring station 3-203, Echo Summit.

6.1.6 Impacts of Land Use

No data were available to evaluate the impact that land use had on runoff quality in the Tahoe Basin. The only station located in an urban area, Station 3-201 at Tahoe Meadows, was activated during the first winter storm event and both sand and salt were distributed.

Land use type may exert some degree of influence on runoff quality in the Tahoe Basin. In the urban areas, a large portion of the accumulated snow is hauled away after every storm, whereas in the rural areas, the snow is plowed off to the shoulder. Hauling away the snow reduces the volume of runoff that can be derived from snowmelt. Plowing also reduces the volume of runoff but some portion of the snow is often left along the shoulder. Runoff volumes during snowmelt events will be larger in the rural areas.

Caltrans maintenance logs indicate more salt was applied to Highway 50 in urban areas during the 2000-2001 winter season than on rural stretches of the highway at similar elevations (i.e., lake level). The additional salt may increase the loads and concentrations of certain parameters like TDS and chlorides in the stormwater runoff as the data suggests when comparing constituents levels from Station 3-201 (Tahoe Meadows) and Station 3-202 (Tahoe Airport).

Street sweeping was performed more frequently within the City of South Lake Tahoe than in the rural areas during 2000 and 2001. Maintenance records for the period of August 2000 to May 2001 indicated street sweeping was conducted on over 80 days along Highway 50 in the City of South Lake Tahoe versus 40 days along rural lake-level sections of the highway and 10 days along high elevation sections. Sweeping would reduce the amount of sand and other accumulated materials left in the road after a snow event. Sweeping prevents this material from being picked up and carried off by the next stormwater runoff event. However, sand and salt were re-applied during each snow event and a portion of this material becomes entrained in the runoff. Consequently, contaminate levels in the urban runoff samples were similar to levels in the rural runoff due to the winter storm procedures.

6.2 Tahoe Sediment Trap Capture Characteristics

The sediment capture characteristics of the double barrel sediment traps was another goals of the Tahoe Basin Stormwater Monitoring Study. The characteristics were evaluated by:

- Comparing the mass of material collected from the up gradient barrel, down gradient barrel, and effluent from the trap.
- Comparing the particle size distribution of the sediment collected from the up gradient barrel, down gradient barrel, and effluent from the trap.
- Identifying the chemical content of various particle size fractions.

6.2.1 Comparison of Mass

Figures 6-1 and 6-2 compare the masses of sediments collected during the two monitoring periods at Stations 3-203 (Echo Summit) and 3-202 (Tahoe Airport). Generally, the results indicate that most of the total sediment mass is retained in the sand traps, with the upgradient trap retaining the highest percentage relative to the downgradient trap. At the Echo Summit site (Figure 6-1), 85 percent of the sediment mass during the first collection period was retained in the up-gradient barrel, 14 percent in the down-gradient barrel, and 1 percent in the filter box (effluent). During the second collection period at Echo Summit, 77 percent of the sediment mass was retained in the up-gradient barrel, 15 percent in the down-gradient barrel, and 7 percent in the filter box (effluent).

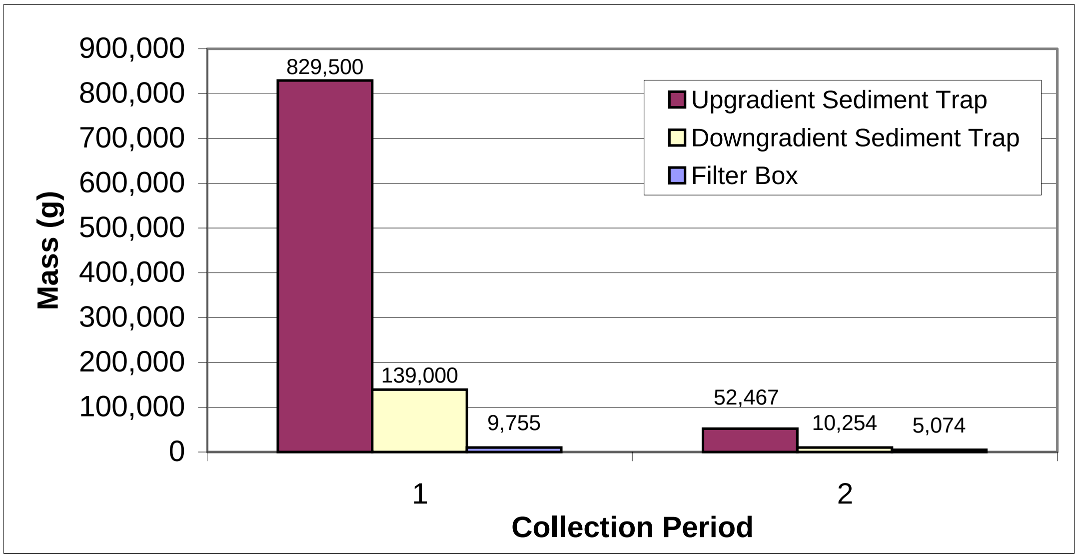


Figure 6-1. Comparison of Sediment Mass from Monitoring Station 3-203 (Echo Summit)

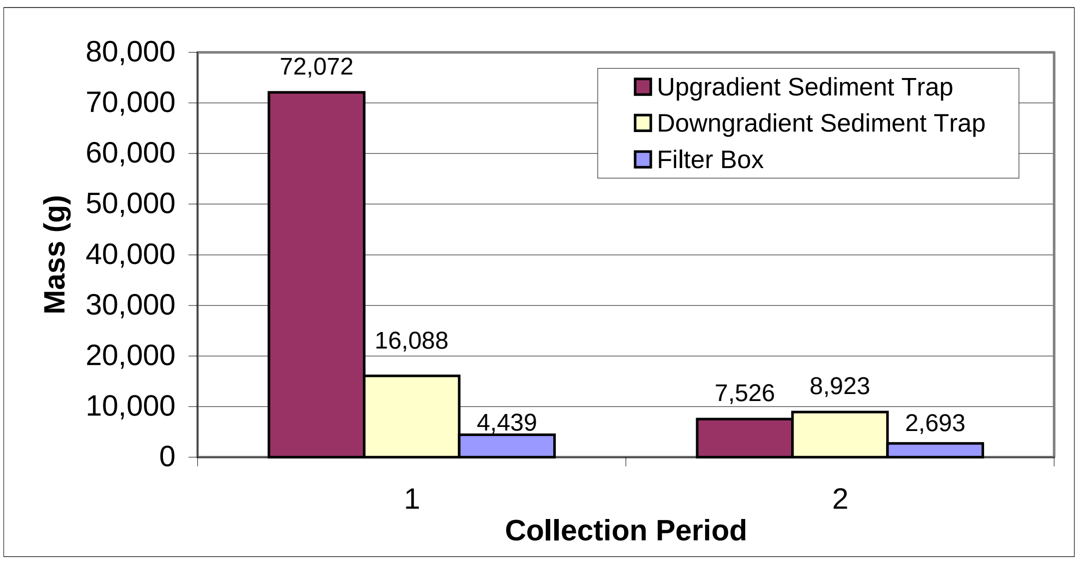


Figure 6-2. Comparison of Sediment Mass from Monitoring Station 3-202 (Tahoe Airport)

At the Tahoe Airport site (Figure 6-2), 78 percent of the sediment mass during the first collection period was retained in the up-gradient barrel, 17 percent in the down-gradient barrel, and 5 percent in the filter box (effluent). During the second collection period at Tahoe Airport, 39 percent of the sediment mass was retained in the up-gradient barrel, 47 percent in the down-gradient barrel, and 14 percent in the filter box (effluent).

As shown in Figures 6-1 and 6-2, the two sand traps remove the majority (greater than 90 percent) of the sediments with a relatively small percentage being discharge in the effluent. However, this is a conservatively high estimate for two reasons: (1) it assumes all sediments are captured and (2) it does not include the small diameter sediments that passed through the filters in the filter boxes. Losses of sediments are believed to have occurred due to the connection between the overflow weir and filter box temporarily disconnected and effluent bypassing the filters when the filters became clogged with material or ice. The mass of small diameter sediments (<0.02 mm) passing through the bottom filter in the filter box cannot currently be estimated.

6.2.2 Comparison of Particle Size Distributions

Particle size distributions for sediment samples collected at monitoring stations 3-203 (Echo Summit) and 3-202 (Tahoe Airport) are presented in Tables 5-4 through 5-7. The results from the sites with sediment traps (stations 3-203 and 3-202) indicate the larger sediments ranging between about 0.07 – 5.0 mm were retained by the up gradient barrels during both monitoring periods at both stations. The down gradient barrels and filter boxes that collected sediment in the effluent retained the smaller sediments ranging between about <0.0024 – 2.0 mm. In most cases, the sediment found in the down gradient barrels and the effluent had similar distributions of particle sizes.

6.2.3 Size Fraction Quality

Figures 6-3 through 6-14 compare the chemical quality of the various composite size fractions obtained from the sediment samples collected at the Echo Summit and Tahoe Airport sites. These data are provided in the form of box plots to enable evaluation of possible trends.

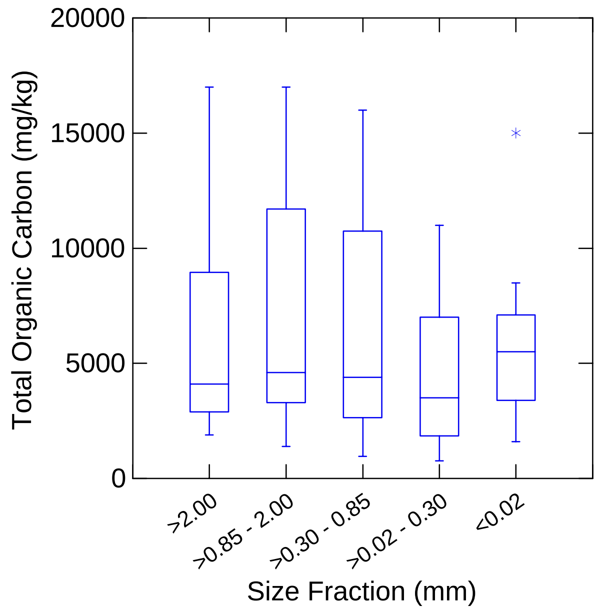


Figure 6-3. Comparison of Chemical Quality versus Size Fraction – Total Organic Carbon.

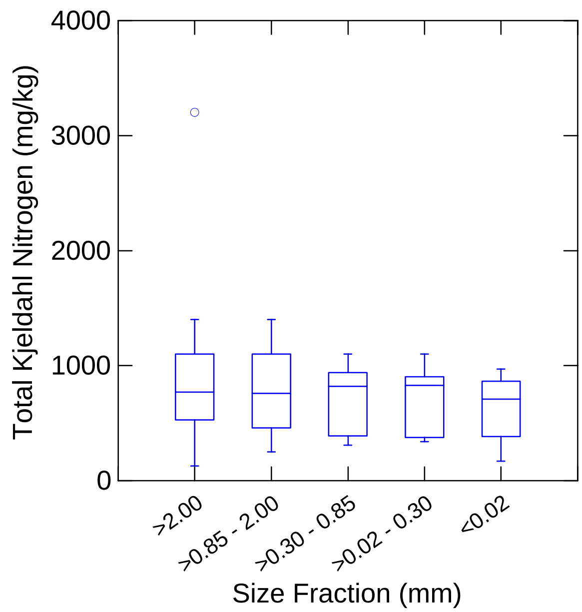


Figure 6-4. Comparison of Chemical Quality versus Size Fraction – Total Kjeldahl Nitrogen.

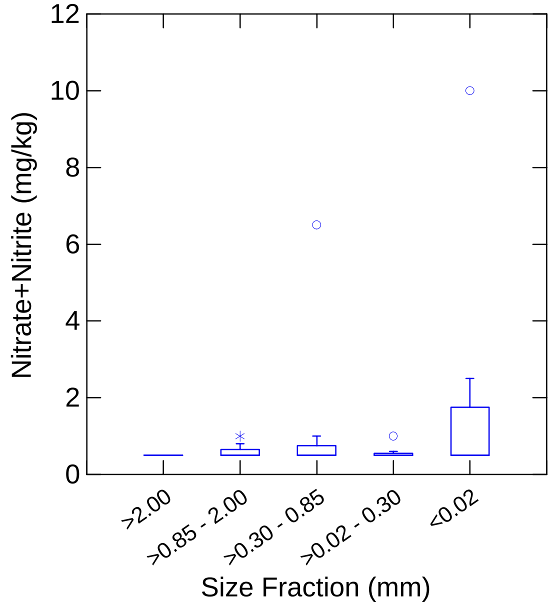


Figure 6-5. Comparison of Chemical Quality versus Size Fraction – Nitrate + Nitrite.

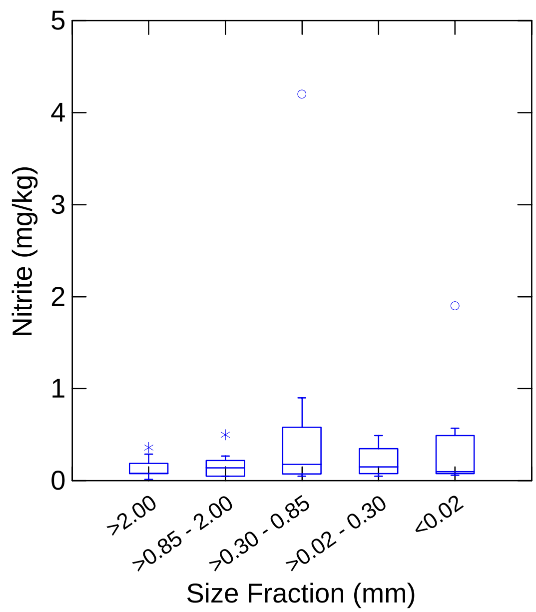


Figure 6-6. Comparison of Chemical Quality versus Size Fraction – Nitrite.

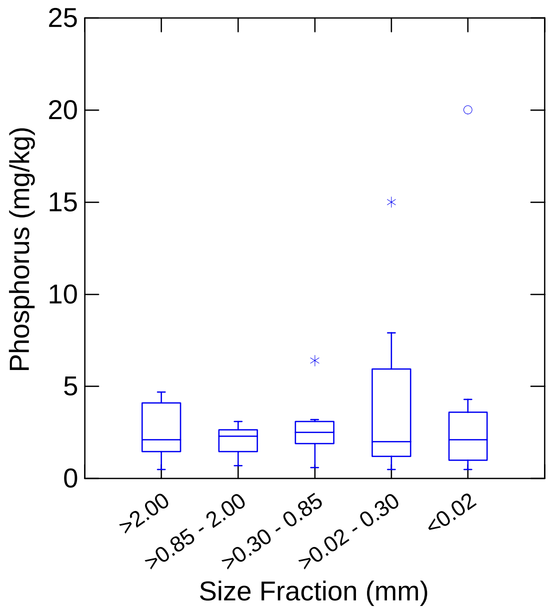


Figure 6-7. Comparison of Chemical Quality versus Size Fraction – Phosphorus.

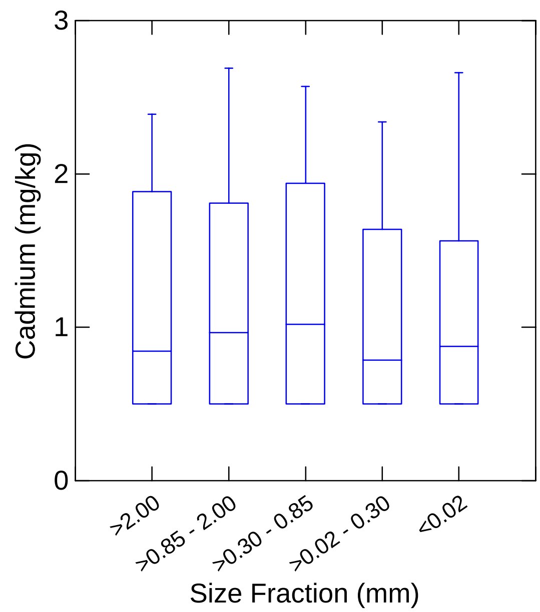


Figure 6-8. Comparison of Chemical Quality versus Size Fraction – Cadmium.

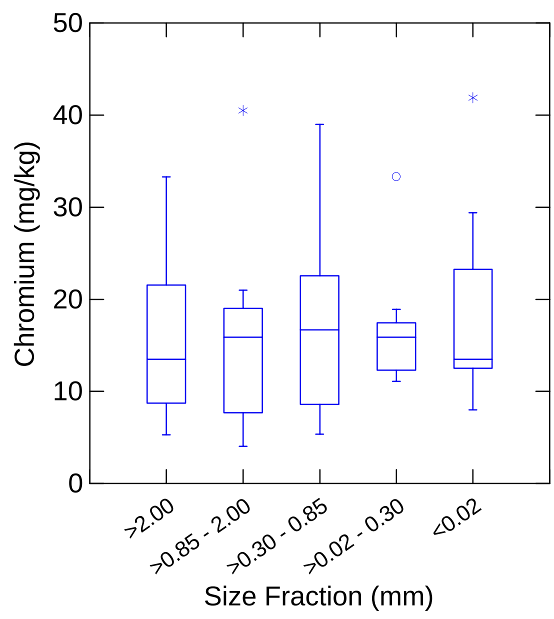


Figure 6-9. Comparison of Chemical Quality versus Size Fraction – Chromium.

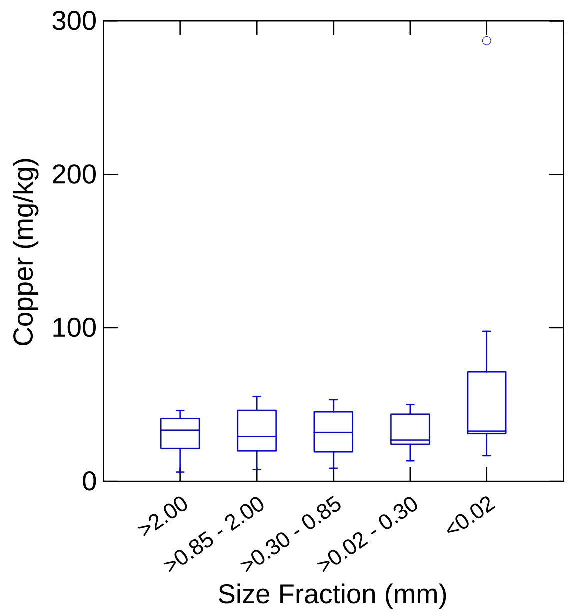


Figure 6-10. Comparison of Chemical Quality versus Size Fraction – Copper.

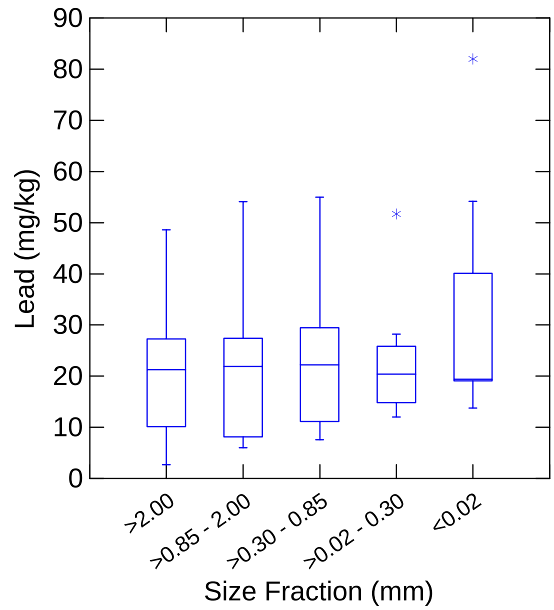


Figure 6-11. Comparison of Chemical Quality versus Size Fraction – Lead.

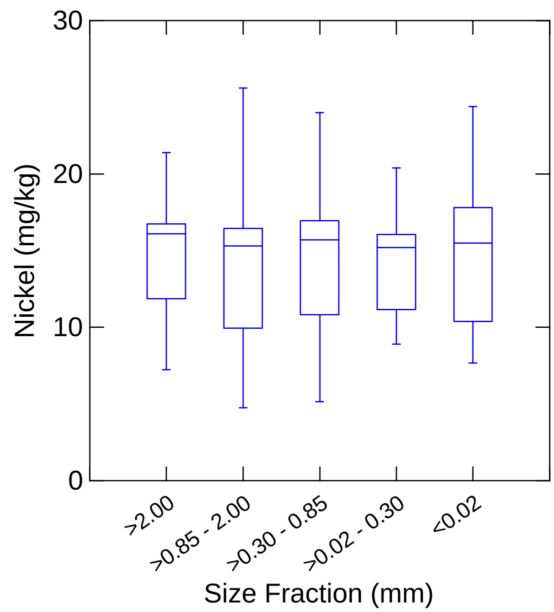


Figure 6-12. Comparison of Chemical Quality versus Size Fraction – Nickel.

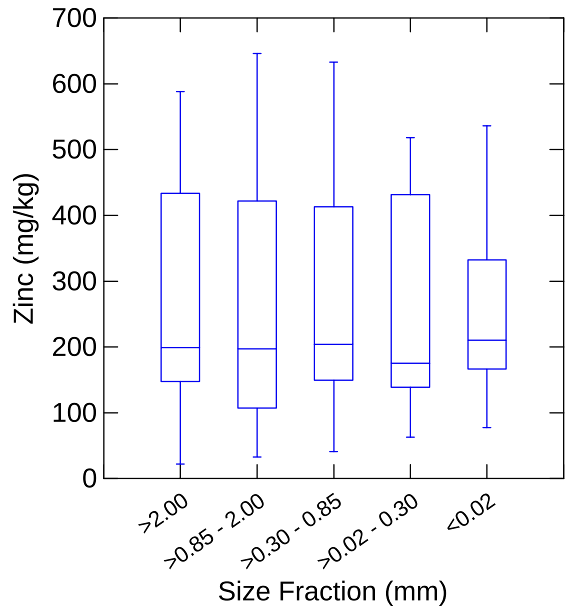


Figure 6-13. Comparison of Chemical Quality versus Size Fraction – Zinc.

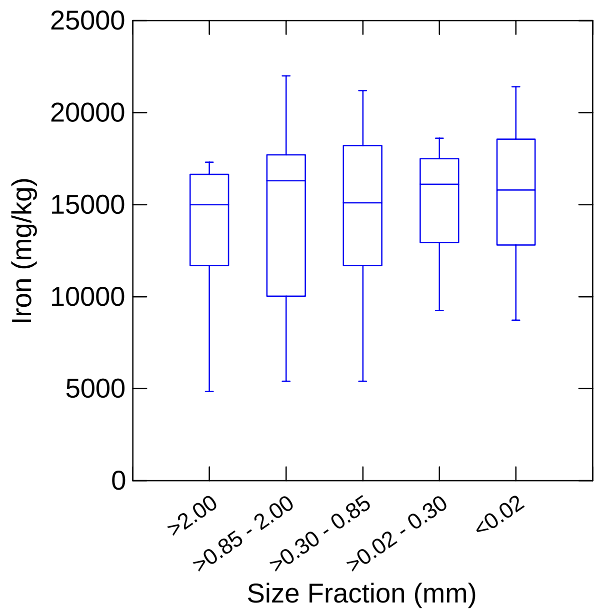


Figure 6-14. Comparison of Chemical Quality versus Size Fraction – Iron.

With the possible exception of iron, none of the 12 chemical parameters exhibited a noticeable trend of concentration with particle size fraction. Iron exhibited a possible slight trend of increasing concentration with decreasing particle size fraction. For two parameters (copper and lead), no trend was evident but generally higher concentrations occurred in the smallest particle size fraction (<0.02 mm). For copper, concentrations in the <0.02 mm size fraction ranged as high as about 100 – 300 mg/kg, while for lead, concentrations in this size fraction ranged as high as about 10 – 80 mg/kg.

6.3 Autosampler Effectiveness

The effectiveness of the autosampler was evaluated by comparing the material collected by the autosampler with the material found in the entire flow stream. The comparisons were made in terms of total mass and particle size distribution.

6.3.1 Comparison of Mass

Figure 6-15 compares the masses of sediments retained on the vacuum extraction filters resulting from filtration of the autosampler and manual bucket samples. Out of the seven cases at the Echo Summit and Zinfandel sites where these comparisons were made, the autosampler had a higher mass in three cases and the manual method had a higher mass in four cases. This indicates no significant difference between the two methods.

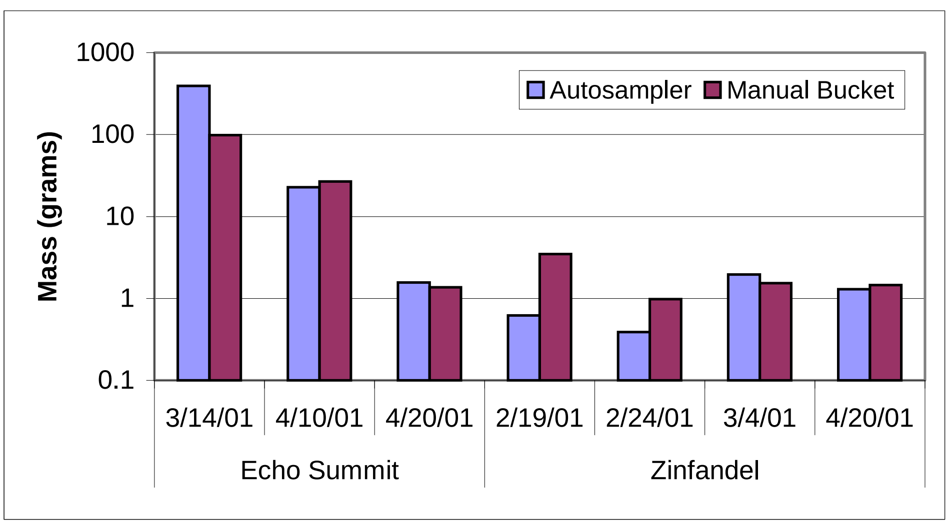


Figure 6-15. Comparison of Sediment Mass for Water Volume / Autosampler System

One possible reason for the similarities between the two methods was the flow stream was very shallow (less than two inches during most sampling times) at both monitoring locations. The shallow flow promoted more complete mixing of the sediment through the water column. Also, the sample strainer had access to a high percentage of the entire water column. Autosampler effectiveness at collecting samples that are representative of the entire flow stream may decrease at locations where the depth of flow is greater and sediment stratification in the water column occurs. Sediment stratification in the water column probably did not occur at either monitoring station.

6.3.2 Comparison of Particle Size Distributions

As described in Sections 3 and 5, an alternative method (particle counting) was necessary to characterize the particle size distributions of the autosampler and water volume sediments collected on the vacuum extraction filters. This method differs from the ASTM D422 method because it counts the number of particles rather than the mass of particles in various size fractions. The particle counting results (Table 5-15) indicate the presence of a large number of very small particles in most samples. However, the mass of these small particles, although they are numerous, is small as indicated by the ASTM D422 results (Sections 5.1.2 and 6.2.2).

Figure 6-16 compares the distribution of particle sizes retained on the vacuum extraction filters for the autosampler and water volume samples. The results indicate that the distribution of particles is similar between the two methods, with most of the particles (85 – 95 percent) occurring in the <0.001 – <0.003 mm range. The large number of small particles of size corresponding to the pore diameter of the filters used with the vacuum extractor explains the "clogging" problem encountered and the difficulty in collecting the masses needed for grain size and chemical analysis.

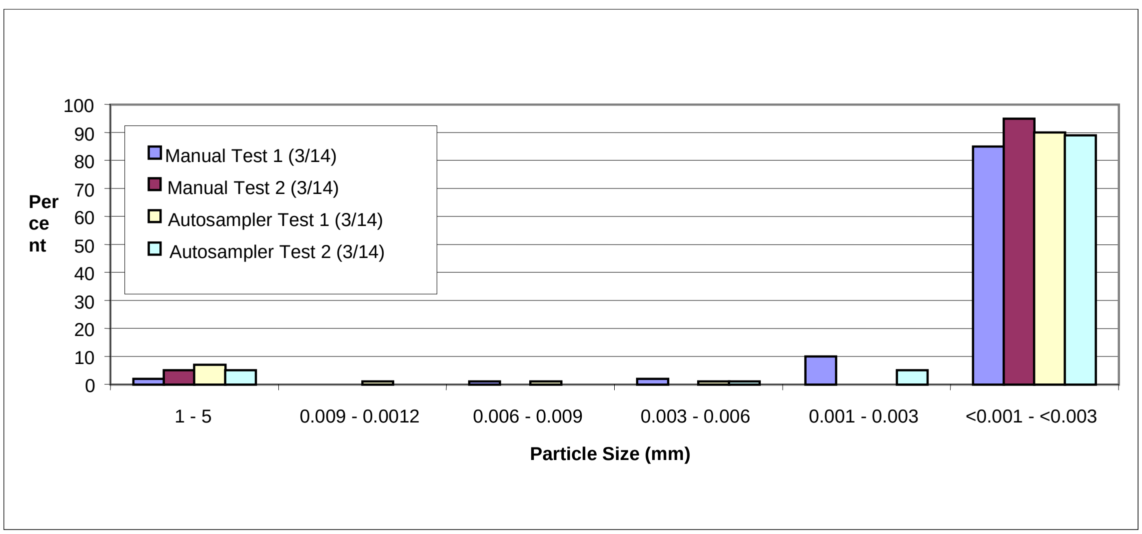


Figure 6-16. Comparison of Particle Counting Results for Water Volume System – Echo Summit Site

Direct comparison of particle counting and grain size data for the filter box (effluent) samples analyzed by both methods is not possible because the densities and volumes of individual size fractions were not measured. However, the particle counting results do indicate that the filter boxes collect the small particles in the <0.001 – <0.003 mm range. These particles are much smaller than the #635 (0.02 mm) mesh screen on the bottom rack of the filter box. Most likely, these small particles are retained due to incomplete "washing" of the sediments through the screens during passive filtration. Their retention may also be due to reduction in effective pore diameter as larger particles are lodged in the screens.

Section 7
Summary and Recommendations

7.1 Summary

7.1.1 Rainfall

1. The 2000-2001 winter season was drier than historical averages based on monthly and seasonal precipitation totals from data collected at precipitation gages and during snow surveys located in the Tahoe Basin and North Lahontan Region.

2. The majority of the precipitation occurs as snowfall that cannot be measured with the existing tipping bucket rain gage technology.

7.1.2 Runoff Monitoring

1. The flow monitoring equipment employed at the three stations was capable of measuring flow rates throughout the year.

2. Runoff coefficients can only be determined from data of a rainfall event. Runoff generated from a snowmelt event cannot be related to the water content of prior snow events because:

   - An unknown portion of the snow is removed from the drainage area during snow management activities;

   - The freezing conditions cause the snow to accumulate over several events, delay the melting, or allow only partial melting to occur before the next snow event.

3. Rainfall events generate higher volumes of runoff than snowmelt events because all the rainfall that falls on the drainage area is directed through the monitoring station.

4. Temperatures often rise above freezing on a daily basis, starting just before noon and lasting till sunset. Runoff is often generated during this period of each day. This pattern continues until the weather changes or all the snow has melted.

7.1.3 Water Quality Sampling

The automatic water quality sampling equipment employed at the three stations was capable of collecting samples throughout the year.

7.1.4 Precipitation Sampling

The precipitation quality sampling equipment employed at the two stations was capable of collecting samples throughout the year.

7.1.5 Runoff Water Quality

1. The data suggests the water quality of runoff from the three Caltrans Tahoe Basin monitoring stations varies among each event, season, and station.

2. Levels of total dissolved solids in the samples of runoff were significantly higher after the start of snow management activities. The source is presumed to be the salt Caltrans applies to the roadways to control snow and ice.

3. The data suggests the conventional pollutants and total metals were at higher concentrations in the runoff after snow management activities began to distribute sand and salt on the roadways. Conversely, nutrient concentrations were lower in runoff samples collected after the start of the snow season.

4. Levels of turbidity, total nitrogen, total phosphorous, and total iron in the samples of highway runoff collected at the three Tahoe Basin monitoring stations were often higher than the water quality limits established for stormwater discharges in the Tahoe Basin. The samples represented untreated stormwater runoff. Treatment was provided at all three stations downstream of the sampling location.

5. The degree to which other factors (land use type and elevation) exert an impact on runoff water quality could not be identified because of the overwhelming impact from the application of sand and salt and the limited database. Land use type and elevation may indirectly impact runoff quality by causing differences in weather conditions and snow management activities.

7.1.6 Sediment Characterization

1. Sediment was collected from the runoff at all three monitoring stations. Particle sizes ranged from less than 0.0024 mm to greater than 9.52 mm with the highest percentage between 0.01 and 2 mm.

2. The majority of the twelve chemical parameters were detected in samples representing three stations and five particle size intervals. Only nitrate/nitrite had a low detection rate, in less than 15 percent of the samples.

3. Postulated trends of increasing chemical concentrations with decreasing sediment size fraction were not evident for any of the twelve constituents. No evidence was found in samples collected at the sediment traps or of the direct runoff. However, two parameters (copper and lead) generally had higher concentrations in the smallest (< 0.02 mm) particle size fraction.

7.1.7 Tahoe Sediment Trap Capture Monitoring

1. Of total mass of sediment captured at the sediment traps, typically the largest percentage is captured by the up-gradient barrel (77 – 85 %) relative to the down-

gradient barrel (14 – 17 %) and effluent (1 – 7 %). In one case (Tahoe Airport, second collection period), a lower percentage of sediment was captured by the up-gradient barrel (39 %) relative to the down-gradient barrel (47 %) and effluent (14 %).

2. Up-gradient barrels capture the larger diameter sediments (> 2 mm), which do not flow into the down-gradient barrels or effluent. Down-gradient barrels capture a higher percentage of the smaller diameter sediments (< 2 mm diameter) relative to the up-gradient barrel. The grain size distributions in the down gradient barrels and effluent are similar, although the effluent tends to contain a higher percentage of the smaller diameter sediments (< 2 mm diameter).

7.1.8 Autosampler Effectiveness

1. Comparison of sediment mass collected by the autosampler relative to the manual (bucket) method indicated no discernable difference between the two methods based on total mass of sediment collected. In one case, the autosampler collected much more sediment mass than the water volume method, probably due to unusual autosampler input tube configuration at this location.

2. Particle counting results indicated no discernable difference in sediment size distribution between the autosampler and manual methods.

3. Comparison of gravimetric and particle counting results indicated that the water volume system (manual bucket method) and the autosampler method are collecting similar sediment fractions. Therefore, the autosampler is collecting a representative sample of the storm water runoff sediments under the hydraulic conditions present at the Echo Summit, Tahoe Airport, and Zinfandel sites. The specific hydraulic conditions at these sites are representative of relatively low to medium intensity storm events and small drainage areas, which result in well-mixed sediments contained in shallow flow volumes. These hydraulic conditions may be typical of monitoring sites in other Caltrans studies.

4. The conclusion that the autosampler is collecting representative sediments is based partially on a particle counting method, which may have limitations. Due to the small size of sample analyzed (< 2 mL), it is likely that the larger particles are not accurately counted by the method, i.e., accuracy improves as particle size decreases. This problem was evident when comparing filter box samples analyzed by both the particle counting method and the ASTM D422 grain size distribution method, which did not agree well for the larger size fractions. For example, in no cases were sediments in the 0.009 – 5 mm size observed with the particle counting method, whereas these particles were shown to be present based on the grain size analyses.

7.2 Recommendations

7.2.1 Rainfall

Partnerships with local entities who operate heated weather stations capable of measuring precipitation amounts year round (National Weather Service, Tahoe Airport, and the City of South Lake Tahoe) were established on a limited basis and some data was received. These partnerships need to be strengthened in order to improve access to the local precipitation data on a regular basis and identify the procedures employed to ensure QA/QC.

7.2.2 Runoff Monitoring

Regular maintenance activities at the Tahoe Airport and Echo summit stations need to include keeping the bubbler and weir free of ice and breaking up any ice that forms in the second barrel where the bubbler and weir are located. Another maintenance activity is ensuring snow management activities do not create temporary berms that divert the runoff away from the monitoring stations. At a minimum, these maintenance activities to be performed every week and prior to each sampling round.

7.2.3 Water Quality Sampling

1. Regular maintenance activities at the Tahoe Airport and Echo summit stations need to include keeping the strainer free of ice. At a minimum, this activity needs to be performed every week and prior to each sampling round.

   The monitoring program needs to be revised to improve the representativeness of samples from multiple day snowmelt events. Alternative approaches to consider include:

   - Collect and analyze a composite sample everyday for multiple-day snowmelt events.
   - Use grab sampling to collect daily samples instead of daily flow-weighted composites.
   - Consider a revised constituent list and standard operating procedures so a single sample can be collected over multiple days without missing holding times.

   Each alternative has different impacts with respect to the representativeness of the sample coverage and budget.

2. A stronger partnership between the Caltrans Tahoe Basin Stormwater Monitoring Program and the Lake Tahoe Interagency Monitoring Program (LTIMP) needs to be developed, similar to the level of participation of District 3. LTIMP provides the opportunity for all monitoring programs in the Tahoe Basin to keep coordinated and share results.

7.2.4 Precipitation Sampling

1. Further consideration is required on how to ensure sufficient sample volume is collected while minimizing contamination from dry deposition. Possible solutions include doubling the number of sampling containers used at each site and installing an automatic sampler with cover.

2. A third precipitation quality monitoring station within the City of South Lake Tahoe should be pursued as originally planned. This station will be used to assist with the assessment of flow data collected at Station 3-201, Tahoe Meadows. Preliminary surveys indicated safe locations were scarce. One option may be to participate with the City of South Lake Tahoe in their stormwater monitoring program. The City operates one weather station and has plans for several more.

3. Results from the 2000-2001 monitoring program suggested the concentrations of pollutants in rainwater were considerable lower than concentrations in the runoff for all parameters except zinc. Additional sampling will need to be conducted to confirm these levels. A full season of monitoring should help in evaluating other factors that may impact the precipitation quality such as a change in season and different land use types.

7.2.5 Runoff Water Quality

The 2000-2001 Tahoe Basin Stormwater Monitoring Program demonstrated storm water runoff could be monitored throughout the season. However, the size of the database needs to be increased in order to complete the characterization of the runoff and identify the controlling factors. The monitoring program should be revised to increase the number of target events per season. The procedures and budget will need to reflect this increase in terms of labor, laboratory analyses, and other associated costs (travel and shipping).

7.2.6 Sediment Characterization

Continuing to monitor sediments into the future will help to increase the existing database, which will increase the ability to recognize trends and improve confidence in findings to date.

7.2.7 Tahoe Sediment Trap Capture Monitoring

1. Large quantities of sediments tended to accumulate in the up-gradient and down-gradient barrels, making it difficult to retrieve, handle, and analyze sediments in the filter bags installed in the two sand traps at Echo Summit and Tahoe Airport. To alleviate this problem, the following recommendations are made:

   - More frequent sampling (i.e., after each individual storm event) should be implemented for rain events during warm weather periods. Filter bags should be used during these events.

- Filter bags should not be used during winter periods where sampling is less frequent. Instead, representative grab and/or core samples should be collected, and the total mass of sediment should be estimated based on depth measurements and moisture content analyses.

2. Larger than anticipated quantities of effluent sediments also accumulated in the filter boxes, resulting in a greater potential for clogging and bypassing. In addition, the mass of sediment that was not retained by the filter box (i.e., small particles that flowed through the filters) could not be estimated based on data collected during investigation. However, the particle counting results indicated that a large number of particles <0.001 to <0.003 mm were present in the storm water flow. Therefore, the following recommendations are made:

   - More frequent collection of sediments captured by the filter box should be initiated, preferably after each individual storm event to reduce accumulation and clogging. This modification alleviates the need to increase the pore diameters or surface area dimensions of the filter fabrics.

   - Grab samples of the filtrate exiting the filter boxes during storm water runoff events should be collected in order to calculate the mass of sediments flowing through the passive filtration system. Total solids analyses should be used in conjunction with total flow volumes (recorded by the autosampler) to calculated total sediment mass.

3. A less robust chemical analysis of the sediment samples is recommended since the chemical analyses generally did not indicate any noticeable trends between concentrations and particle sizes for the 12 parameters analyzed. In the current procedure, the sediment samples collected from the up-gradient barrel, down-gradient barrel, and effluent are analyzed separately for five particle size intervals.

   One alternative would to analyze a single composite sample from each site. Another alternative could be to divide the composite sample into the five particle size intervals and analyze each interval separately.

4. During the past season, the sediment traps were unable to quantify all sediment entering and leaving the trap. Field procedures should be developed so all of the sediment entering and leaving the traps can be quantified.

7.2.8 Autosampler Effectiveness

1. The vacuum extraction/filtration method was generally not capable of collecting the 65 – 100 g of sediment necessary to perform the ASTM grain size analysis method, due to an insufficient volume of water/sediment sample and rapid clogging of the filters. In most cases, it was only practical to collect at most 2 g of sediment by filtering 10 liters of sample. Thus, in order to collect the required mass for the ASTM method, about 300 – 500 liters of sample would need to be

filtered, which would probably require 50 – 100 filter discs per sample. This would be an impractically large and extensive effort to perform in the field.

Based on these considerations, the following recommendations are proposed:

- Discontinue the water volume system method at the Echo Summit, Tahoe Airport, and Zinfandel sites.
- Evaluate hydraulic conditions at other study sites. If typical depth of storm water flow is less than 2 – 3 inches, or is otherwise similar to conditions at Echo Summit, Tahoe Airport, or Zinfandel, it is probably not necessary to conduct further evaluations of autosampler representativeness. If not, further study (at these other sites) is warranted.

2. The ASTM grain size distribution method provided useful information for evaluating the particle size distributions of various sediments collecting during the investigation; however, the particle counting method results exhibited limited usefulness. Therefore, the following recommendations are made:

   - Discontinue the particle counting method.
   - Continue the ASTM D422 grain size distribution method, where applicable.

Section 8 References

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Section 9
Glossary

AADT	Annual Average Daily Traffic
As	Arsenic
Caltrans	California Department of Transportation
Cd	Cadmium
CDM	Camp Dresser & McKee
cfs	Cubic feet per second
cf	Cubic feet
Cr	Chromium
Cu	Copper
Composite sample	A series of discrete samples collected by the automated sampler and composited at the laboratory.
CV	Coefficient of variation; the ratio of the standard deviation to the mean
Discrete sample	A single or series of samples collected by the automated sampler into one sample bottle.
DOC	Dissolved Organic Carbon
DOP	Dissolved Ortho-Phosphate
DWR	State of California Department of Water Resources
EC	Electrical conductivity, same as specific conductance
EMC	Event mean concentration. The concentration reported for a flow composite sample.
Grab Sample	A single sample collected to represent instantaneous conditions.
HRD	Hardness

LCS	Laboratory control sample. A clean matrix spiked with known concentrations of target analytes that is used to evaluate laboratory accuracy, independent of matrix effects.
LTIMP	Lake Tahoe Interagency Monitoring Program
MB	Method blank. Reagent water (Type II) that is taken through the entire analytical procedure and used to evaluate contamination from laboratory procedures or conditions.
mg/L	Milligram per Liter
mL	Milliliter
mm	Millimeter
MS/MSD	Matrix spike/matrix spike duplicate. An environmental sample spiked with known concentrations of target analytes that is used to evaluate the accuracy and precision of the laboratory extraction and analysis procedures.
NO3	Nitrate
Ni	Nickel
NWS	National Weather Service
Pb	Lead
POR	Period of Record
QA/QC	Quality Assurance/Quality Control
RPD	Relative percent difference. The RPD is the ratio of the difference between two values to the average of the two values.
RL	Reporting limits. Minimum value that can be reported with confidence for any given parameter as established by a specific laboratory.

Runoff Volume	The volume of storm water that runs over the surface of the ground and into a storm drainage system and receiving water.
SAP	Sampling and Analysis Plan
Sample reporting limit	The lowest concentration that can be reliably achieved within specified limits of precision and accuracy, multiplied by a factor that accounts for sample-specific matrix interference.
SC	Specific Conductance
SOP	Standard Operating Procedure
Station 3-201	Monitoring station located along HY 50 at Tahoe Meadows residential development in City of South Lake Tahoe
Station 3-202	Monitoring station located along HY 50 near Tahoe Airport
Station 3-203	Monitoring station located along HY 50 below Echo Summit
Station 3-07	Monitoring station located along HY 50 near intersection with Zinfandel Road
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TSS	Total Suspended Solids
µg/L	Micrograms per liter
µmhos/cm	Micromhos per centimeter
Zn	Zinc

Appendix A
Storm Event Summaries

Appendix A-1
Storm Event Summaries from Station 3-201 (Tahoe Meadows)

Monitoring Station 3-201 (Highway 50 at Tahoe Meadows - South Lake Tahoe)
Storm Event #1 - October 26, 2000

Station Characteristics

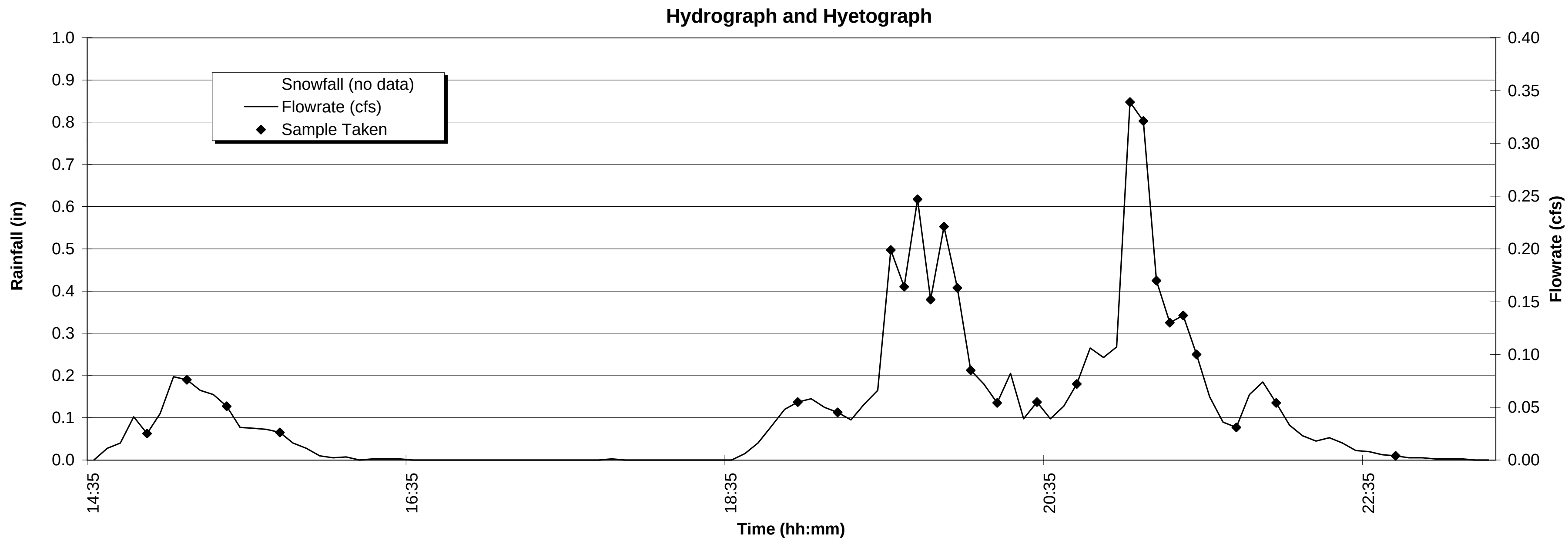
Est. Drainage Area (acres):	0.77
Predicted Runoff Coefficient:	0.9
Actual Runoff Coefficient:	N/A

Precipitation Data Summary

Type of Precipitation:	Mix
Total Precipitation (in.):	N/A
Days Since Last 0.1 in.:	6

Storm Flow Data Summary

Total Flow Volume (cf):	1,427
Peak Flow (cfs):	0.08
Samples Taken:	25
Samples Attempted:	25
Sample Pacing Volume (cf):	55
Estimated % Capture:	>90%



Monitoring Station 3-201 (Highway 50 at Tahoe Meadows - South Lake Tahoe)
Storm Event #2 - January 24, 2001

Station Characteristics

Est. Drainage Area (acres):	0.77
Predicted Runoff Coefficient:	0.9
Actual Runoff Coefficient:	N/A

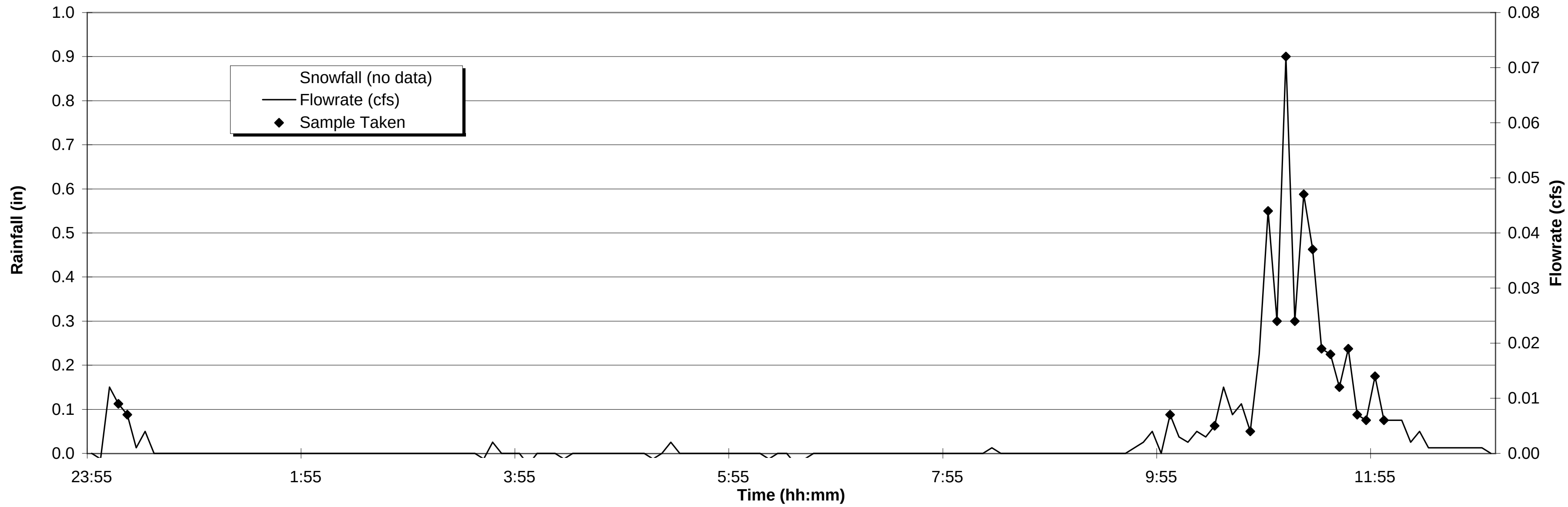
Precipitation Data Summary

Type of Precipitation:	Snow
Total Precipitation (in.):	N/A
Days Since Last 0.1 in.:	1

Storm Flow Data Summary

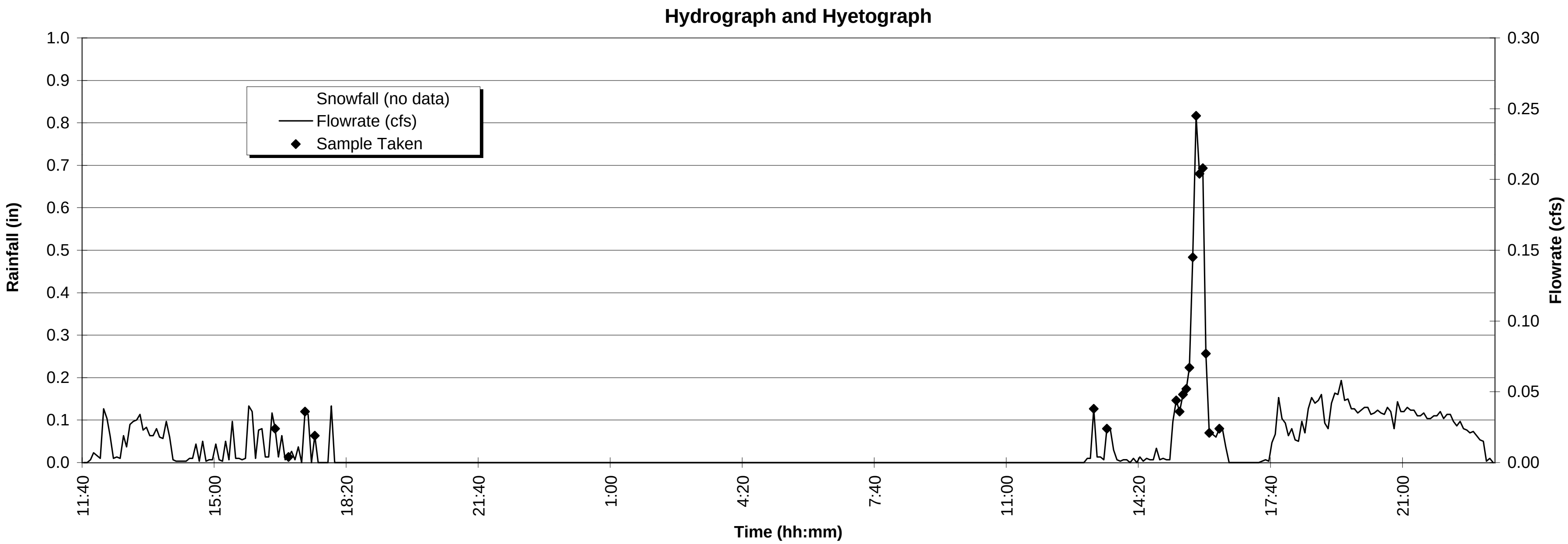
Total Flow Volume (cf):	145
Peak Flow (cfs):	0.072
Samples Taken:	19
Samples Attempted:	19
Sample Pacing Volume (cf):	8
Estimated % Capture:	>90%

Hydrograph and Hyetograph



Monitoring Station 3-201 (Hgihway 50 at Tahoe Meadows - South Lake Tahoe)
Storm Event #3 - March 8-9, 2001

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.77	Total Flow Volume (cf):	1,355
Predicted Runoff Coefficient:	0.9	Peak Flow (cfs):	0.245
Actual Runoff Coefficient:	N/A	Samples Taken:	24
		Samples Attempted:	25
Precipitation Data Summary		Sample Pacing Volume (cf):	55
Type of Precipitation:	Snow	Estimated % Capture:	>60%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	1		



Monitoring Station 3-201 (Highway 50 at Tahoe Meadows - South Lake Tahoe)
Storm Event #4 - March 25, 2001

Station Characteristics

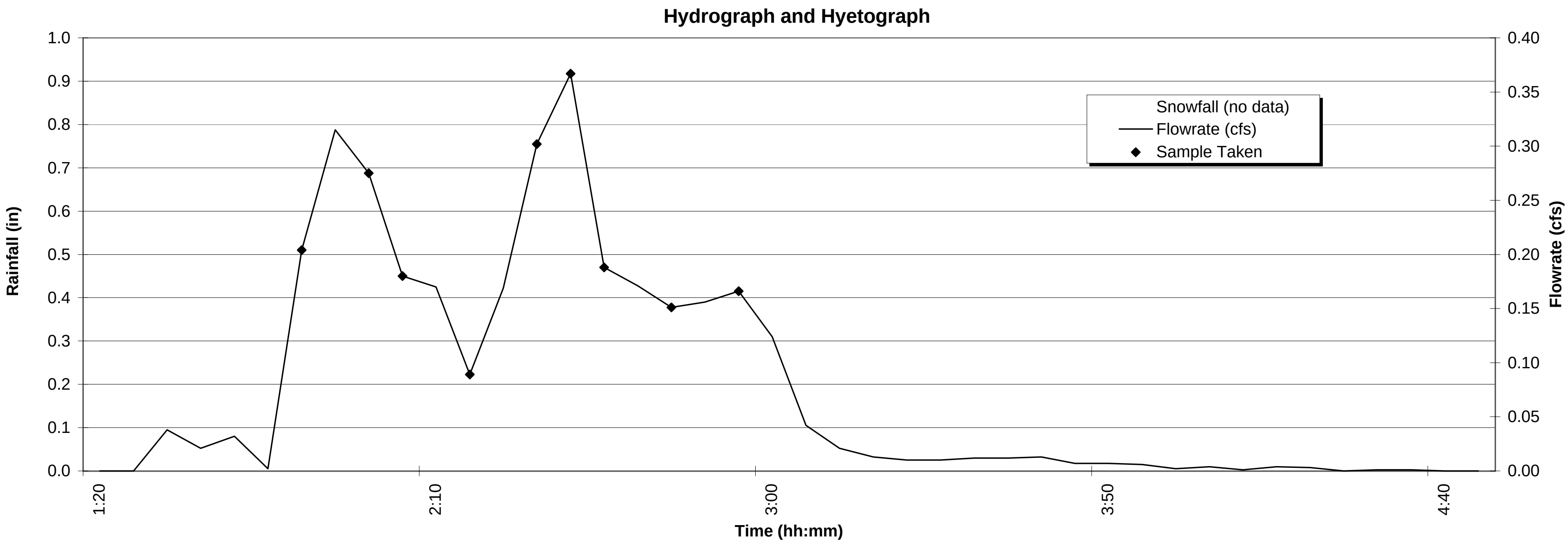
Est. Drainage Area (acres):	0.77
Predicted Runoff Coefficient:	0.9
Actual Runoff Coefficient:	N/A

Precipitation Data Summary

Type of Precipitation:	Snow
Total Precipitation (in.):	N/A
Days Since Last 0.1 in.:	3

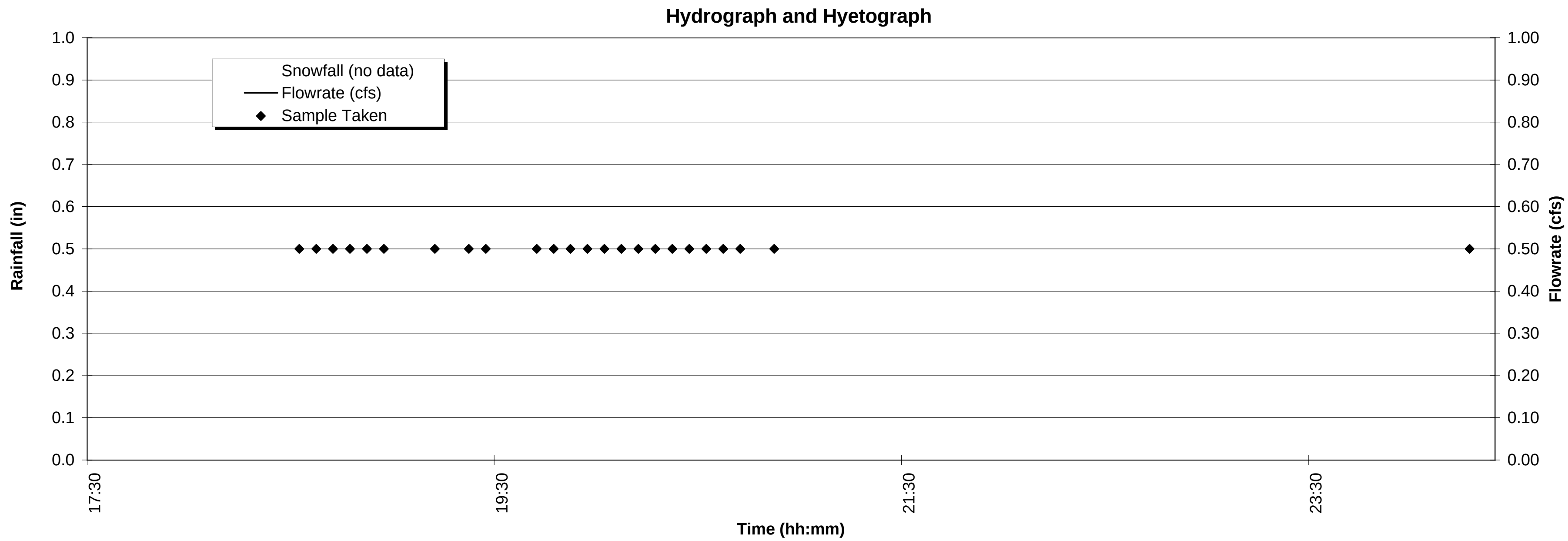
Storm Flow Data Summary

Total Flow Volume (cf):	987
Peak Flow (cfs):	0.367
Samples Taken:	9
Samples Attempted:	10
Sample Pacing Volume (cf):	8
Estimated % Capture:	>90%



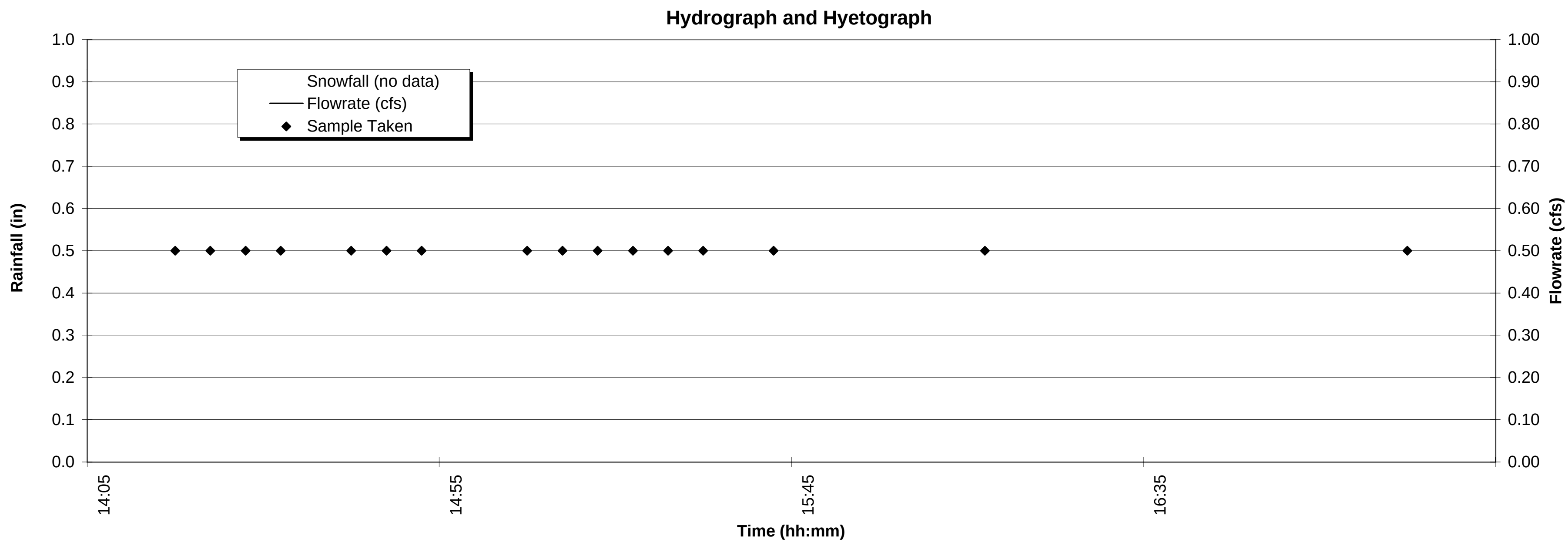
Monitoring Station 3-201 (Highway 50 at Tahoe Meadows - South Lake Tahoe)
Storm Event #5 - April 18, 2001

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.77	Total Flow Volume (cf):	790
Predicted Runoff Coefficient:	0.9	Peak Flow (cfs):	N/A
Actual Runoff Coefficient:	N/A	Samples Taken:	36
		Samples Attempted:	39
Precipitation Data Summary		Sample Pacing Volume (cf):	16
Type of Precipitation:	Mix	Estimated % Capture:	>90%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	7		



Monitoring Station 3-201 (Highway 50 at Tahoe Meadows - South Lake Tahoe)
Storm Event #6 - April 20, 2001

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.77	Total Flow Volume (cf):	780
Predicted Runoff Coefficient:	0.9	Peak Flow (cfs):	N/A
Actual Runoff Coefficient:	N/A	Samples Taken:	20
		Samples Attempted:	20
Precipitation Data Summary		Sample Pacing Volume (cf):	39
Type of Precipitation:	Mix	Estimated % Capture:	>90%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	1		

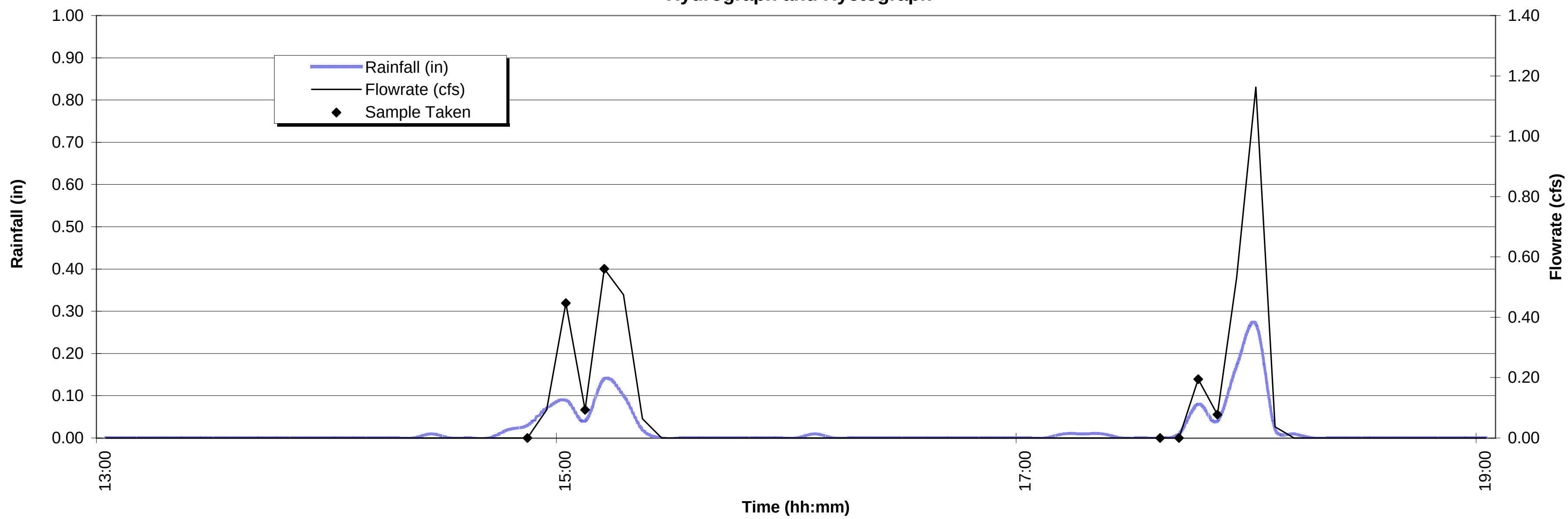


Appendix A-2
Storm Event Summaries from Station 3-202 (Tahoe Airport)

Monitoring Station 3-202 (Highway 50 at Tahoe Airport)
Storm Event #1 - August 3, 2000

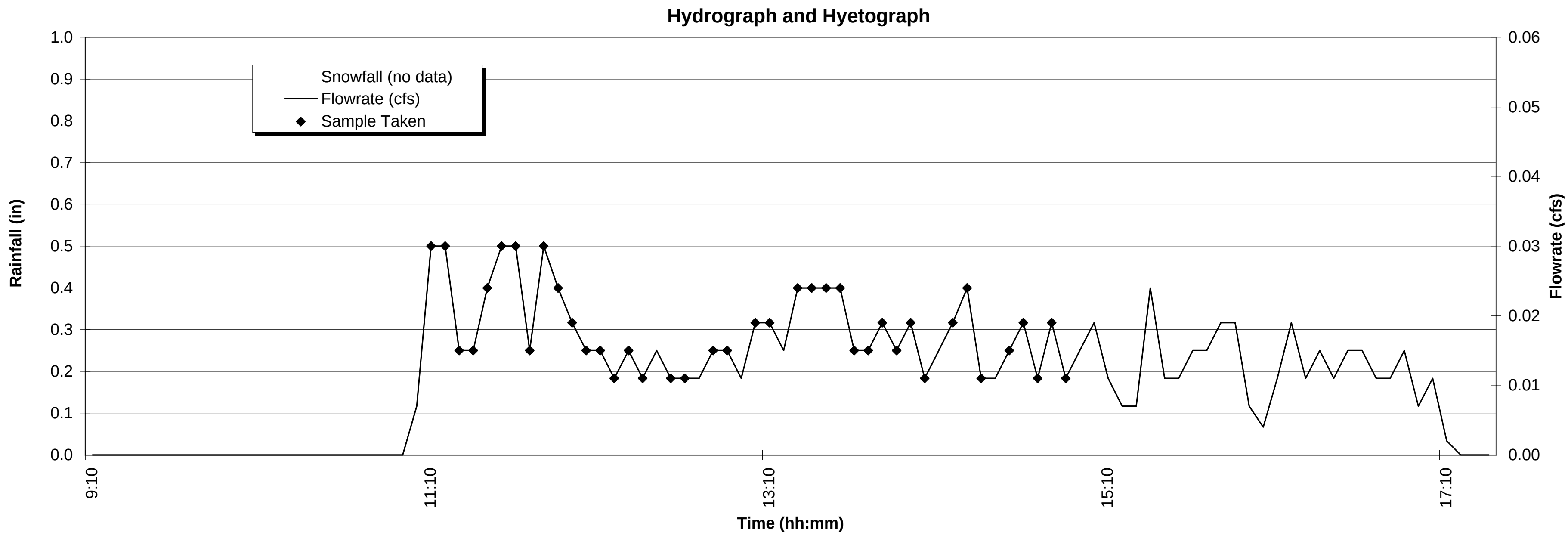
Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.33	Total Flow Volume (cf):	1,121
Predicted Runoff Coefficient:	0.8	Peak Flow (cfs):	1.16
Actual Runoff Coefficient:	0.81	Samples Taken:	19
		Samples Attempted:	19
Precipitation Data Summary		Sample Pacing Volume (cf):	15
Type of Precipitation:	Rain	Estimated % Capture:	>50%
Total Precipitation (in.):	1.16		
Days Since Last 0.1 in.:	2		

Hydrograph and Hyetograph



Monitoring Station 3-202 (Highway 50 at Tahoe Airport)
Storm Event #2 - February 20, 2001

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.33	Total Flow Volume (cf):	348
Predicted Runoff Coefficient:	0.8	Peak Flow (cfs):	0.03
Actual Runoff Coefficient:	N/A	Samples Taken:	40
		Samples Attempted:	40
Precipitation Data Summary		Sample Pacing Volume (cf):	9
Type of Percipitation:	Snow	Estimated % Capture:	>70%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	1		



Monitoring Station 3-202 (Highway 50 at Tahoe Airport)
Storm Event #3 - February 21, 2001

Station Characteristics

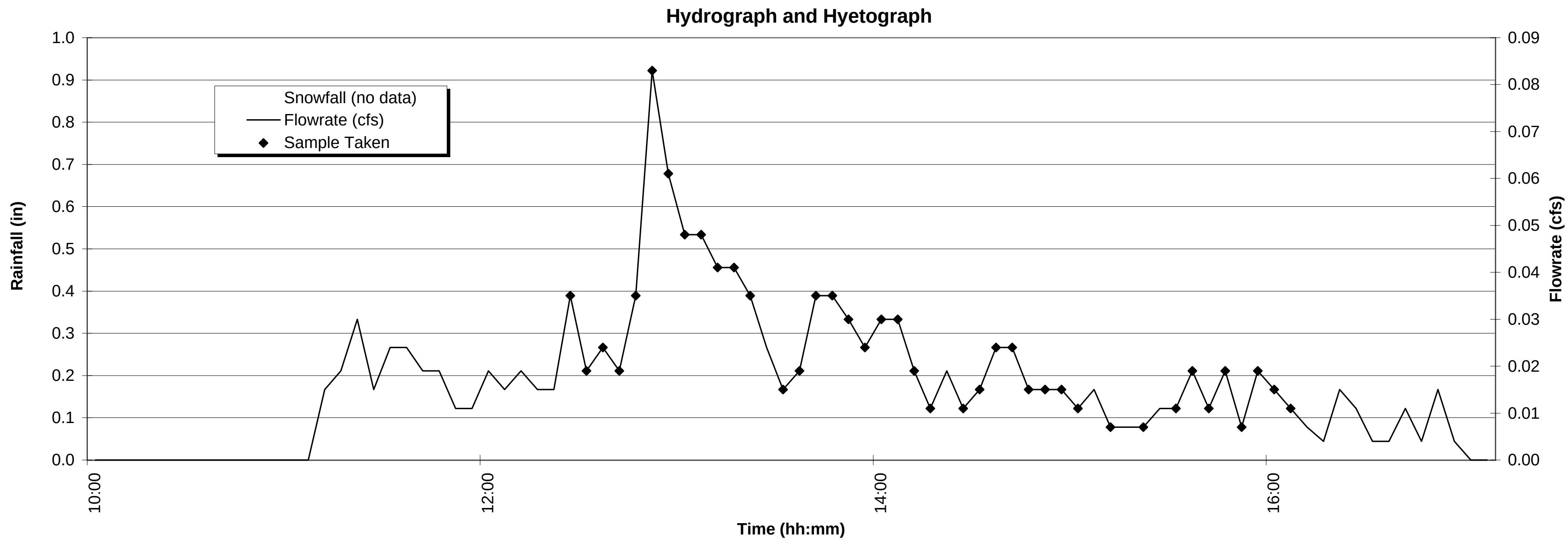
Est. Drainage Area (acres):	0.33
Predicted Runoff Coefficient:	0.8
Actual Runoff Coefficient:	N/A

Precipitation Data Summary

Type of Precipitation:	Snow
Total Precipitation (in.):	N/A
Days Since Last 0.1 in.:	1

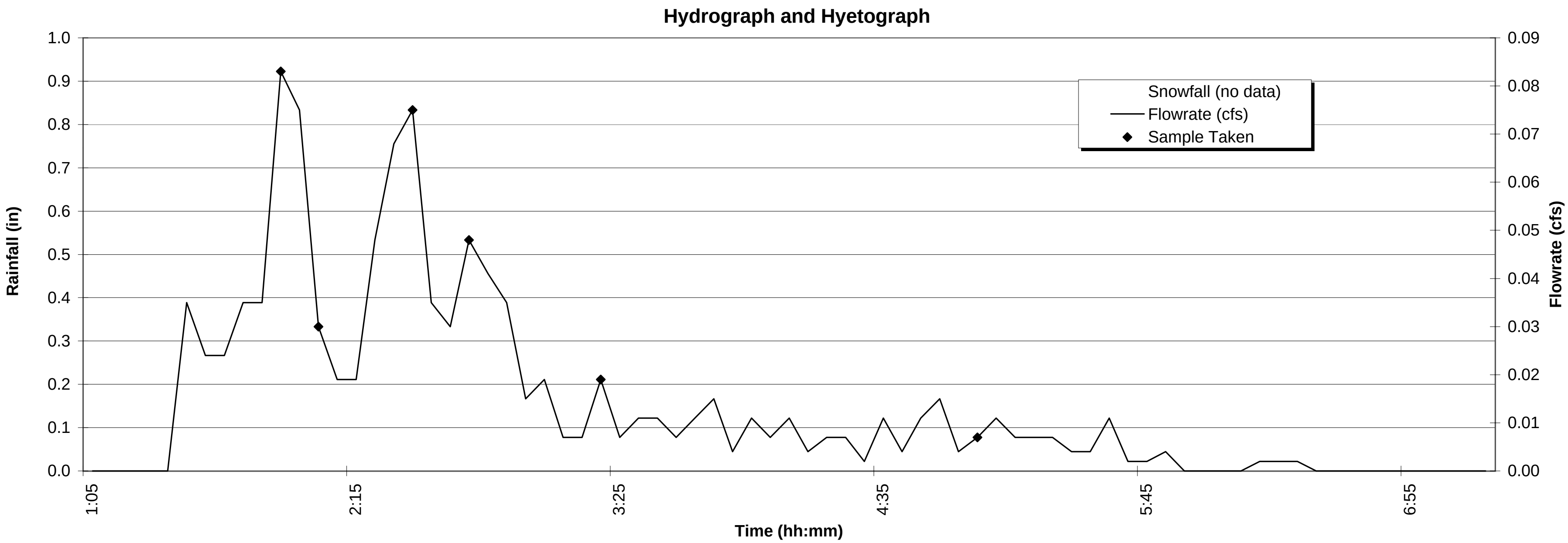
Storm Flow Data Summary

Total Flow Volume (cf):	425
Peak Flow (cfs):	0.083
Samples Taken:	40
Samples Attempted:	40
Sample Pacing Volume (cf):	9
Estimated % Capture:	>70%



Monitoring Station 3-202 (Highway 50 at Tahoe Airport)
Storm Event #4 - March 25, 2001

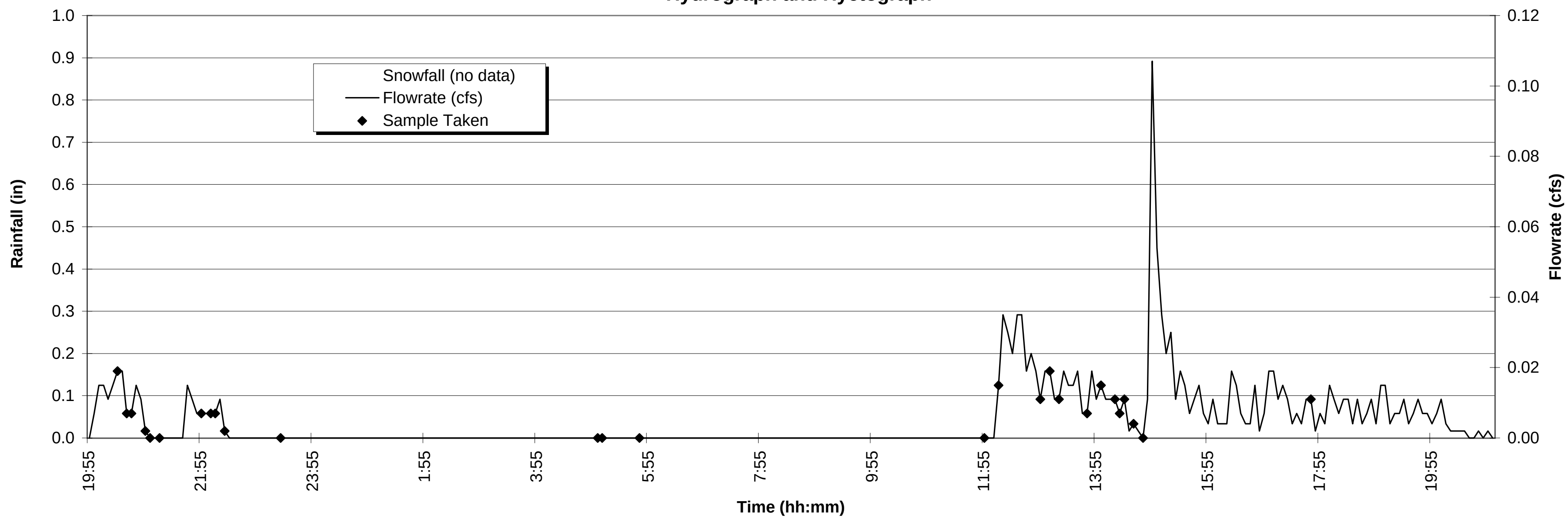
Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.33	Total Flow Volume (cf):	317
Predicted Runoff Coefficient:	0.8	Peak Flow (cfs):	0.083
Actual Runoff Coefficient:	N/A	Samples Taken:	6
		Samples Attempted:	6
Precipitation Data Summary		Sample Pacing Volume (cf):	47
Type of Precipitation:	Snow	Estimated % Capture:	>90%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	3		



Monitoring Station 3-202 (Highway 50 at Tahoe Airport)
Storm Event #5 - April 6-7

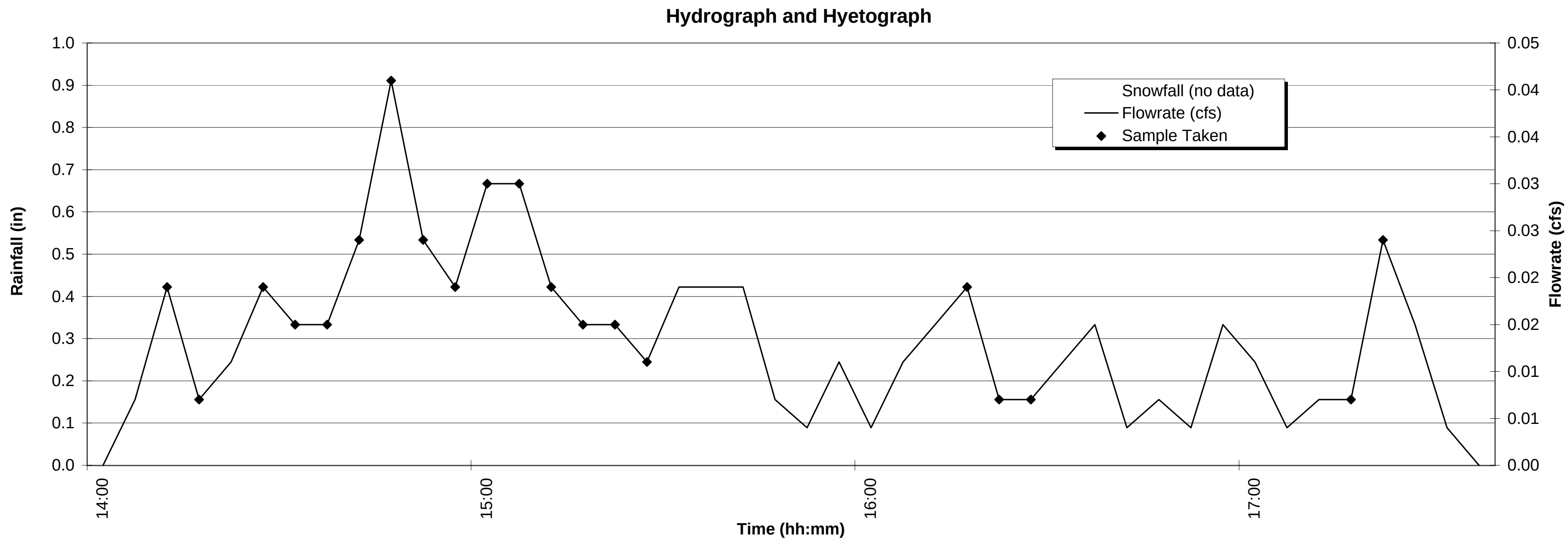
Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.33	Total Flow Volume (cf):	440
Predicted Runoff Coefficient:	0.8	Peak Flow (cfs):	0.107
Actual Runoff Coefficient:	N/A	Samples Taken:	27
		Samples Attempted:	27
Precipitation Data Summary		Sample Pacing Volume (cf):	9
Type of Precipitation:	Snow	Estimated % Capture:	>50%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	10		

Hydrograph and Hyetograph



Monitoring Station 2-202 (Highway 50 at Tahoe Airport)
Storm Event #6 - April 11, 2001

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.33	Total Flow Volume (cf):	177
Predicted Runoff Coefficient:	0.8	Peak Flow (cfs):	0.041
Actual Runoff Coefficient:	N/A	Samples Taken:	20
		Samples Attempted:	23
Precipitation Data Summary		Sample Pacing Volume (cf):	9
Type of Precipitation:	Snow	Estimated % Capture:	>90%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	2		



Monitoring Station 3-202 (Highway 50 at Tahoe Airport)
Storm Event #7 - April 18-19, 2001

Station Characteristics

Est. Drainage Area (acres):	0.33
Predicted Runoff Coefficient:	0.8
Actual Runoff Coefficient:	N/A

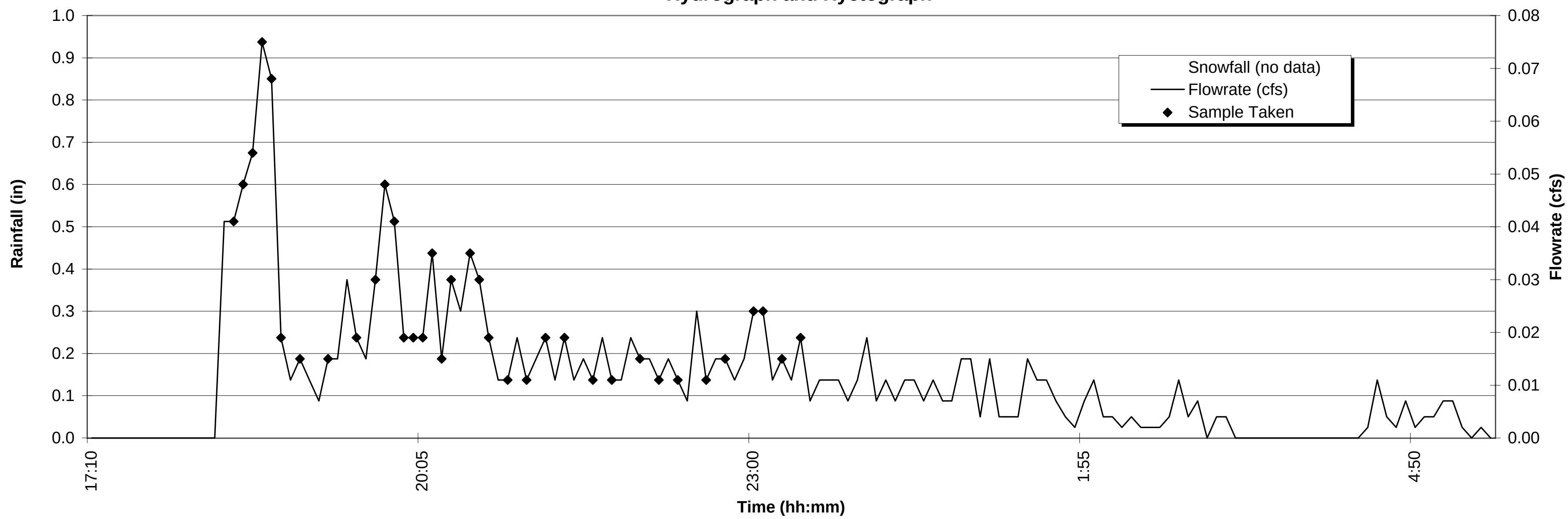
Precipitation Data Summary

Type of Precipitation:	Mix
Total Precipitation (in.):	N/A
Days Since Last 0.1 in.:	6

Storm Flow Data Summary

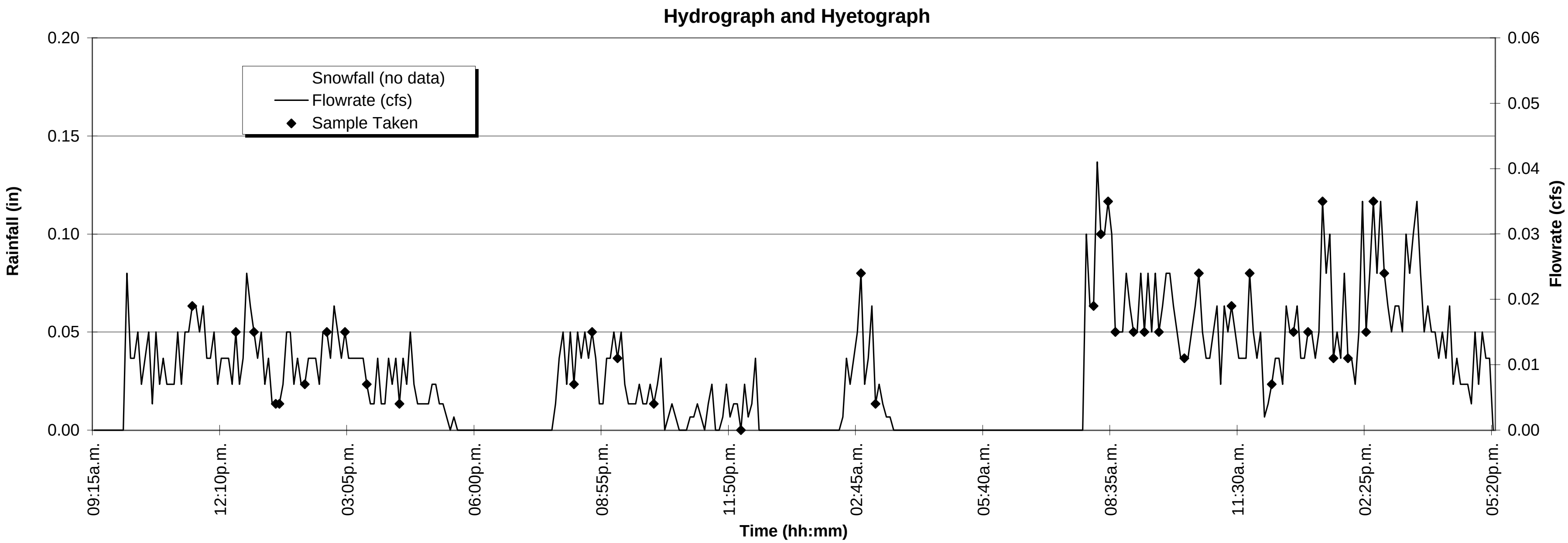
Total Flow Volume (cf):	517
Peak Flow (cfs):	0.075
Samples Taken:	36
Samples Attempted:	36
Sample Pacing Volume (cf):	9
Estimated % Capture:	>80%

Hydrograph and Hyetograph



Monitoring Station 3-202 (Highway 50 at Tahoe Airport)
Storm Event #8 - April 19-20, 2001

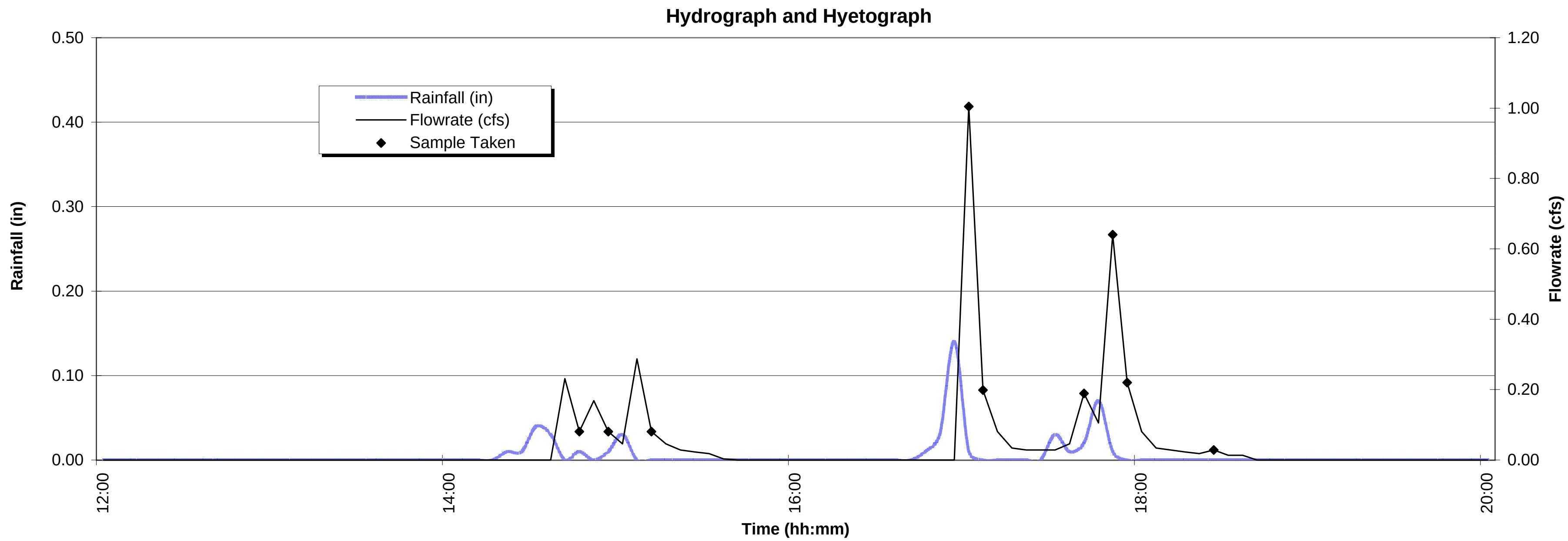
Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.33	Total Flow Volume (cf):	996
Predicted Runoff Coefficient:	0.8	Peak Flow (cfs):	0.041
Actual Runoff Coefficient:	N/A	Samples Taken:	37
		Samples Attempted:	37
Precipitation Data Summary		Sample Pacing Volume (cf):	9
Type of Precipitation:	Mix	Estimated % Capture:	>80%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	1		



Appendix A-3
Storm Event Summaries from Station 3-203 (Echo Summit)

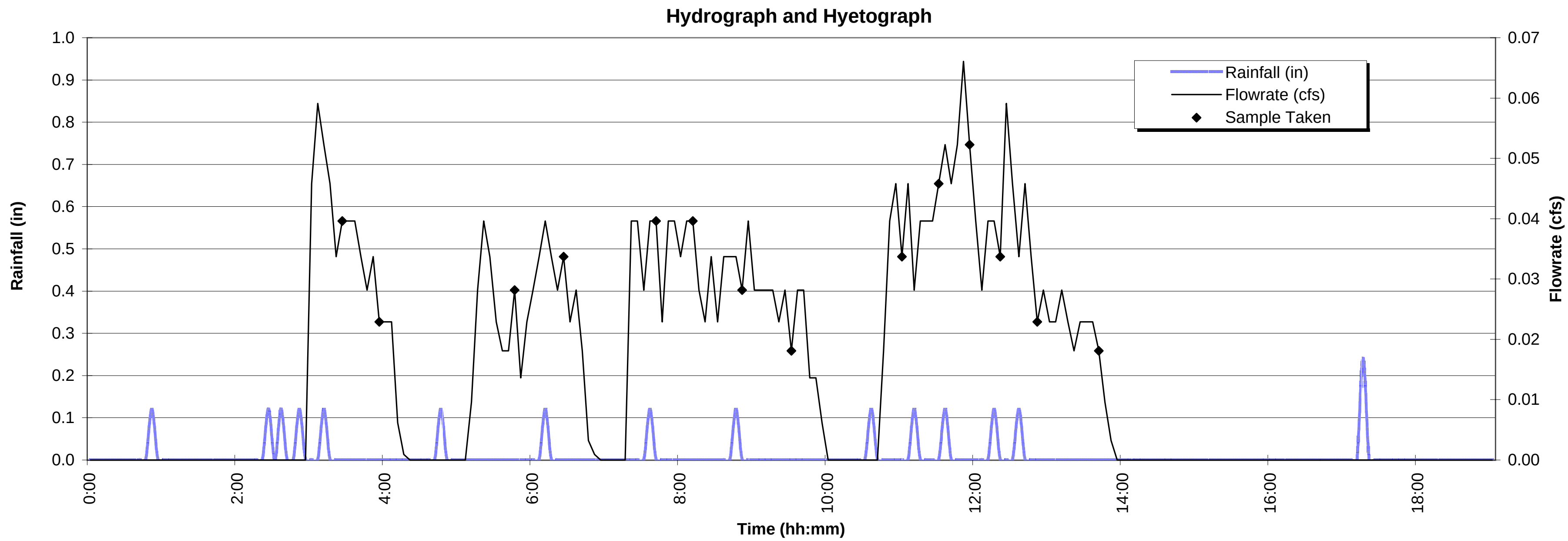
Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #1 - August 3, 2000

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.7	Total Flow Volume (cf):	1,181
Predicted Runoff Coefficient:	0.95	Peak Flow (cfs):	1.00
Actual Runoff Coefficient:	0.99	Samples Taken:	12
		Samples Attempted:	12
Precipitation Data Summary		Sample Pacing Volume (cf):	98
Type of Precipitation:	Rain	Estimated % Capture:	>90%
Total Precipitation (in.):	0.47		
Days Since Last 0.1 in.:	2		



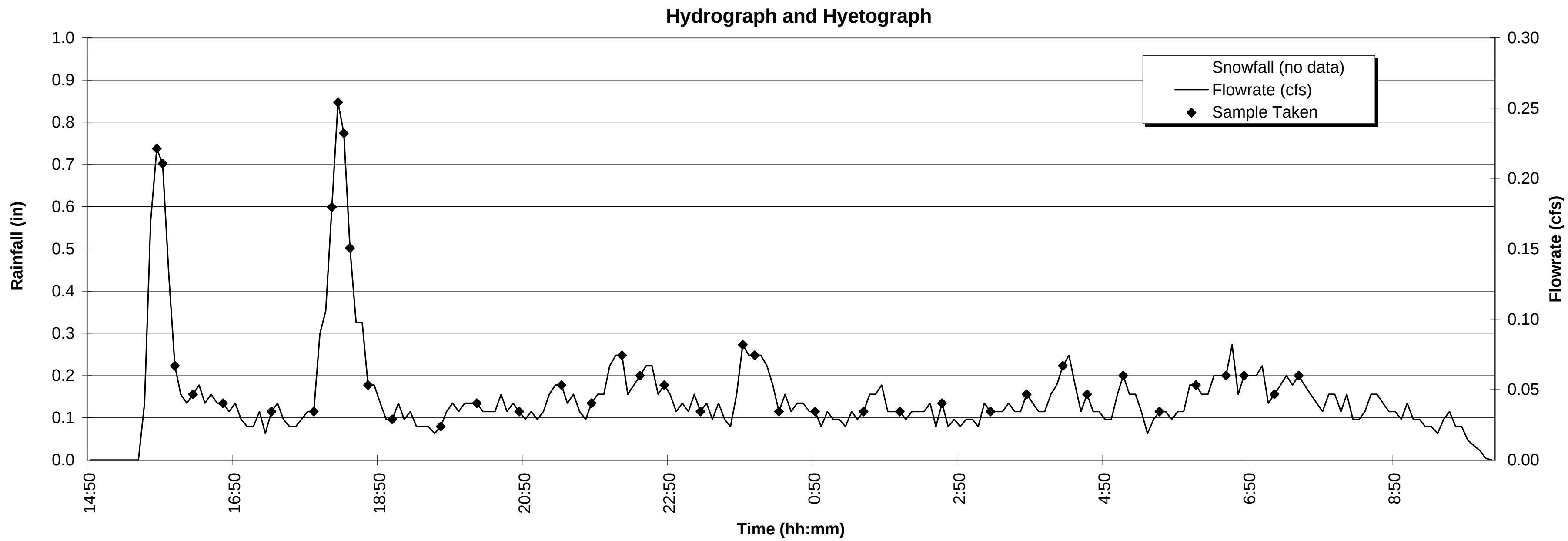
Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #2 - August 30, 2000

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.7	Total Flow Volume (cf):	987
Predicted Runoff Coefficient:	0.95	Peak Flow (cfs):	0.07
Actual Runoff Coefficient:	2.43	Samples Taken:	14
		Samples Attempted:	14
Precipitation Data Summary		Sample Pacing Volume (cf):	75
Type of Precipitation:	Rain	Estimated % Capture:	>90%
Total Precipitation (in.):	0.16		
Days Since Last 0.1 in.:	17		



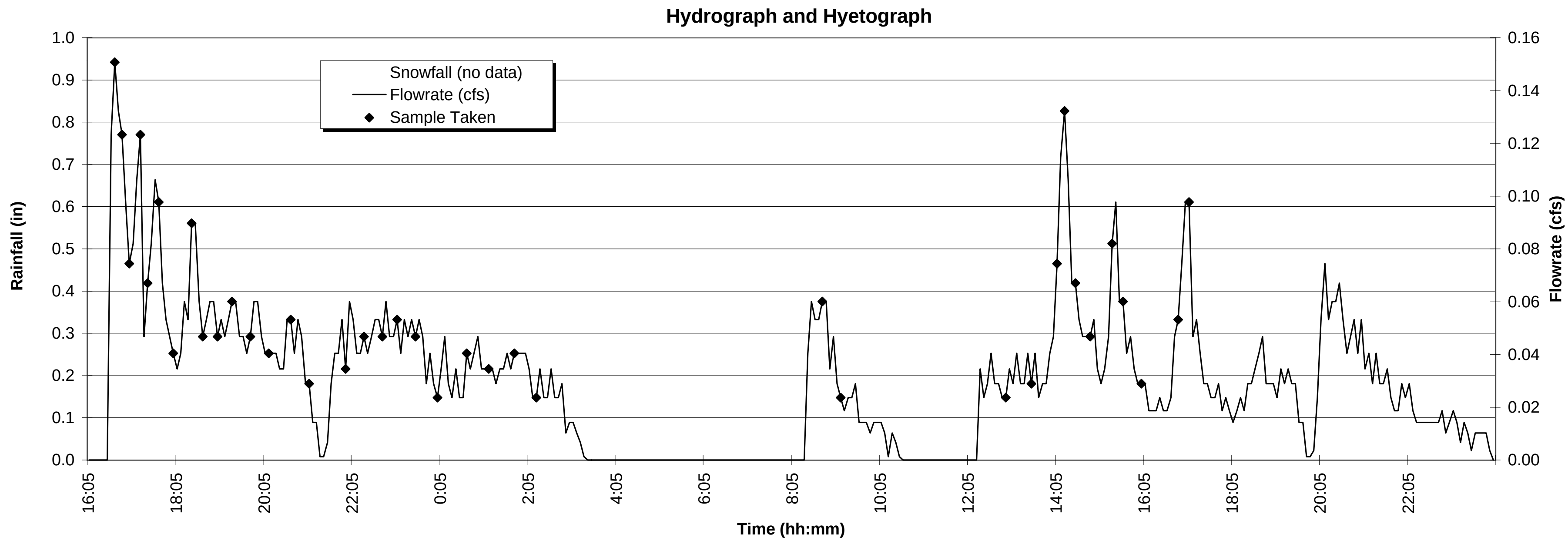
Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #3 - October 9-10, 2000

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.7	Total Flow Volume (cf):	3,112
Predicted Runoff Coefficient:	0.95	Peak Flow (cfs):	0.25
Actual Runoff Coefficient:	N/A	Samples Taken:	40
		Samples Attempted:	40
Precipitation Data Summary		Sample Pacing Volume (cf):	60
Type of Precipitation:	Mixed	Estimated % Capture:	>90%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	39		



Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #4 - October 25-26, 2000

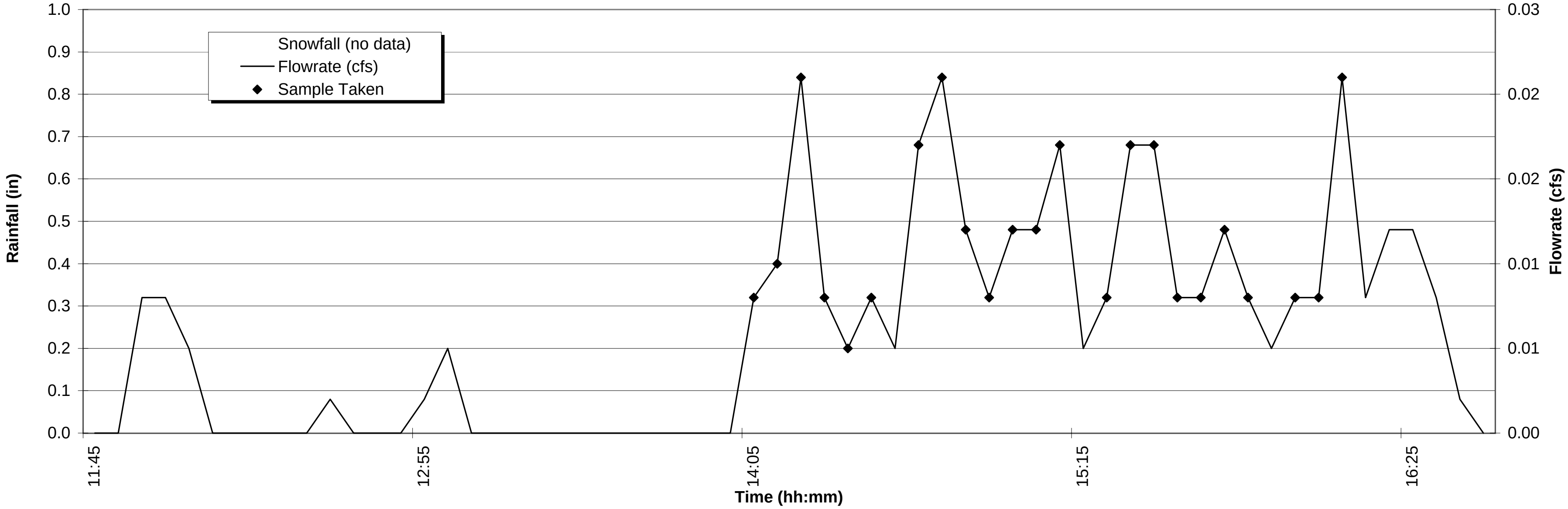
Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.7	Total Flow Volume (cf):	3,475
Predicted Runoff Coefficient:	0.95	Peak Flow (cfs):	0.15
Actual Runoff Coefficient:	N/A	Samples Taken:	38
		Samples Attempted:	40
Precipitation Data Summary		Sample Pacing Volume (cf):	30
Type of Precipitation:	Snow	Estimated % Capture:	>80%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	6		



Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #5 - March 10, 2001

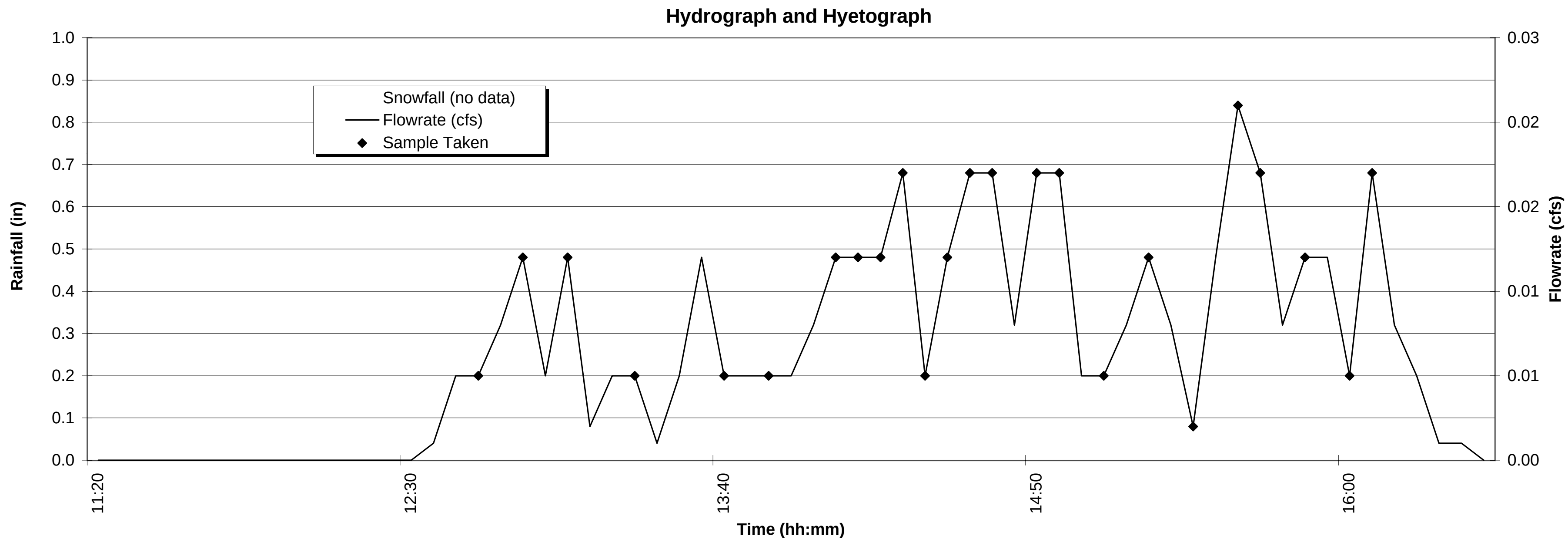
Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.7	Total Flow Volume (cf):	108
Predicted Runoff Coefficient:	0.95	Peak Flow (cfs):	0.021
Actual Runoff Coefficient:	N/A	Samples Taken:	29
		Samples Attempted:	34
Precipitation Data Summary		Sample Pacing Volume (cf):	5
Type of Precipitation:	Snow	Estimated % Capture:	>90%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	1		

Hydrograph and Hyetograph



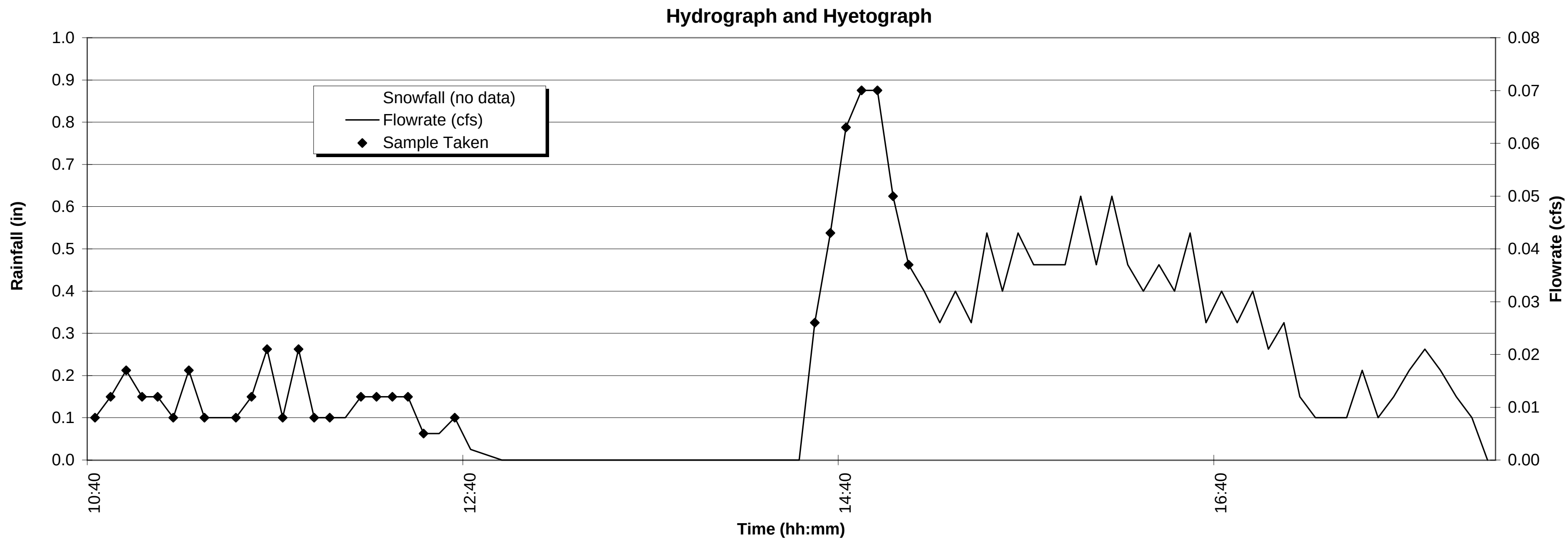
Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #6 - March 11, 2001

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.7	Total Flow Volume (cf):	123
Predicted Runoff Coefficient:	0.95	Peak Flow (cfs):	0.021
Actual Runoff Coefficient:	N/A	Samples Taken:	24
		Samples Attempted:	25
Precipitation Data Summary		Sample Pacing Volume (cf):	5
Type of Precipitation:	Snow	Estimated % Capture:	>90%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	1		



Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #7 - April 6, 2001

Station Characteristics		**Storm Flow Data Summary**	
Est. Drainage Area (acres):	0.7	Total Flow Volume (cf):	477
Predicted Runoff Coefficient:	0.95	Peak Flow (cfs):	0.07
Actual Runoff Coefficient:	N/A	Samples Taken:	28
		Samples Attempted:	28
Precipitation Data Summary		Sample Pacing Volume (cf):	9
Type of Precipitation:	Snow	Estimated % Capture:	>50%
Total Precipitation (in.):	N/A		
Days Since Last 0.1 in.:	10		



Monitoring Station 3-203 (Highway 50 near Echo Summit)
Storm Event #8 - April 11, 2001

Station Characteristics

Est. Drainage Area (acres):	0.7
Predicted Runoff Coefficient:	0.95
Actual Runoff Coefficient:	N/A

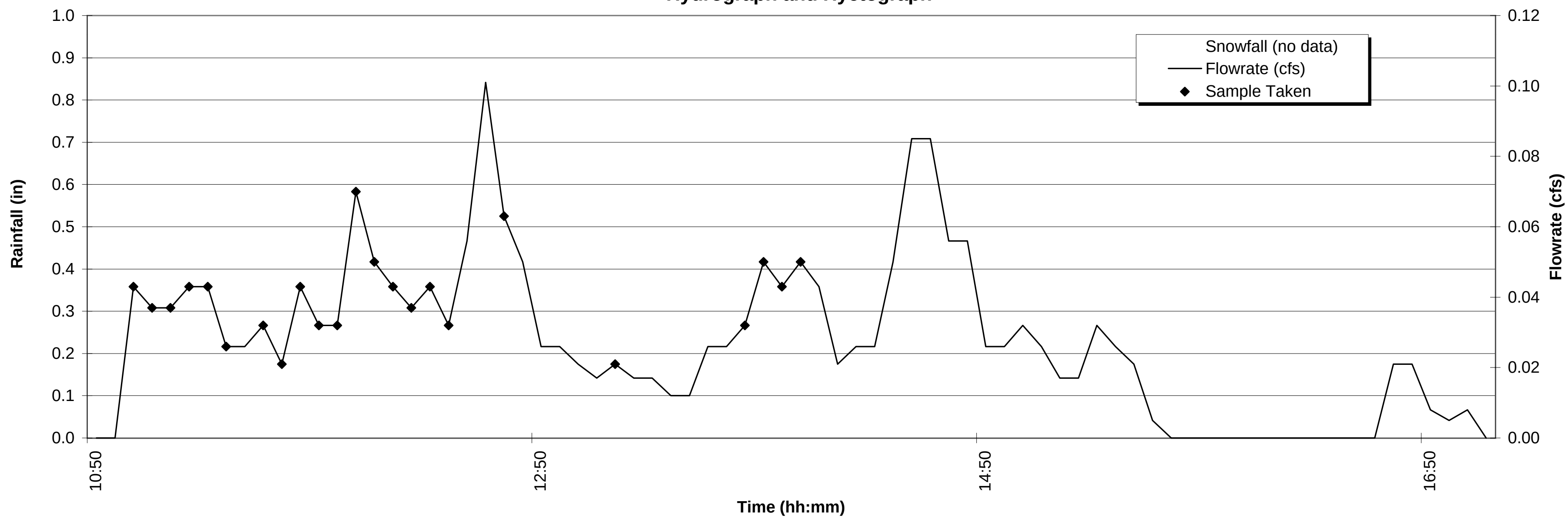
Precipitation Data Summary

Type of Precipitation:	Mix
Total Precipitation (in.):	N/A
Days Since Last 0.1 in.:	2

Storm Flow Data Summary

Total Flow Volume (cf):	629
Peak Flow (cfs):	0.101
Samples Taken:	28
Samples Attempted:	40
Sample Pacing Volume (cf):	9
Estimated % Capture:	>80%

Hydrograph and Hyetograph



Appendix B
Water Quality Analytical Results

Table B.1

Runoff Quality for Monitoring Site 3-201 (Tahoe Meadows - #4)

		Sample End Date:	10/26/00	01/24/01	03/09/01	03/25/01	04/19/01	04/21/2001
		Event ID:	2000-1	2000-2	2000-3	2000-4	2000-5	2000-6
		Unit of Measure						
Conventionals	pH	pH Units	6.75 J	8.00	7.54 J	7.71	8.33	8.53 J
	EC	umhos/cm	199	1210	3580	652	757	1840
	TSS	mg/L	220	5100	3240	179	511	1110
	TDS	mg/L	150	7030	2310	357	467	970
	Hardness as CaCO3	mg/L	72	412	200	36	32	76
	DOC	mg/L	18	46.6	43.7	29.3	46.5	15
	TOC	mg/L	21	45.8	48.4	33.7	53.5	16.5
	Turbidity	NTUs		8.2 J	143 J	388 J	301	467 J
	Chloride	mg/L	35	3700	950	140	170	510
	Oil & Grease	mg/L						
Nutrients	Nitrate 3 (as N)	mg/L		0.28 J	0.83 J	0.43	0.46	0.14 J
	TKN	mg/L	2.1	0.6	5.6	0.7	0.8	0.7
	Total Phosphorus	mg/L	0.49	3.14	9.9	1.65	0.68 J	2.72
	Diss. Ortho-Phosphate	mg/L	0.06 J	0.1	0.05 J	0.26	0.24	0.08 J
Total Metals	Total Arsenic	ug/L	0.5 UJ	25.5	8.74	5.6	7.08	7.4
	Total Cadmium	ug/L	0.561 J	3.02	2	0.927	0.91	1.49
	Total Chromium	ug/L	16.2	120	45.3	31.6	17.4	26.5
	Total Copper	ug/L	27.7 J	170	77.5	50.4	44.9	59.8
	Total Iron	ug/L	5230	162000	59800	21400	9110 J	19900
	Total Nickel	ug/L	7.17	67	26.2 J	22.1	11.6	16.4
	Total Lead	ug/L	21.2	367	152	54.8	31.3	64.5
	Total Zinc	ug/L	187 J	1030 J	542 J	336	297 J	417 J
Dissolved Metals	Dissolved Arsenic	ug/L	0.5 UJ	1.05	2.51	2.38	5.28	3.03
	Dissolved Cadmium	ug/L	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
	Dissolved Chromium	ug/L	9.5	5.64	5.02	5.62	7.35	7.78
	Dissolved Copper	ug/L	10.1 J	6.45	8.93	15.2	17.2	19.8
	Dissolved Iron	ug/L	209	67.1	99.4	303	478 J	303
	Dissolved Nickel	ug/L	2.65	3.3	2.54 J	2.54	3.41	2.26
	Dissolved Lead	ug/L	1 U	1 U	1.51	1 U	1.54	3.44
	Dissolved Zinc	ug/L	56 J	21.8 J	30.1 J	18.8	32.9 J	31.6 J

J = Estimated concentration (in accordance with Caltrans EDD Checker)
U = Not detected at a concentration greater than the reporting limit shown.

Table B.2

Runoff Quality for Monitoring Site 3-202 (Tahoe Airport - #5)

		Sample End Date:	08/03/00	02/20/01	02/21/01	03/25/01	04/07/01	04/12/01	04/18/01	04/20/2001
		Event ID:	2000-1	2000-2	2000-3	2000-4	2000-5	2000-6	2000-7	2000-8
		Unit of Measure								
Conventionals	pH	pH Units	6.59	7.79	8.17	7.45	7.07 J	7.91	8.28	7.8 J
	EC	umhos/cm	39	841	372	479	1270	7860	824	3220
	TSS	mg/L	48	3020	26	1270	1230	1440	704	1100
	TDS	mg/L	27	4430	1810	240	868	4240	460	1650
	Hardness as CaCO3	mg/L	12	190	124	48	70	156	20	84
	DOC	mg/L	10.6	16.9	9.1	16.7	18.5	20	19.5	16.8
	TOC	mg/L	12.8	29.3	9.9	18.1	20	23	24	16.5
	Turbidity	NTUs	39	2620	1300	588	680 J	493	403	700 J
	Chloride	mg/L	1 U	2600	1200	120	300	2300	200	970
	Oil & Grease	mg/L	5 U							
Nutrients	Nitrate 3 (as N)	mg/L	0.41	0.36 J	0.34	0.22	0.24 J	0.31	0.25	0.17 J
	TKN	mg/L	2.5	3.1	0.8		1.3	0.7	0.6	0.7
	Total Phosphorus	mg/L	0.17	0.08	0.48	0.15	0.52 J	0.79 J	0.55 J	3.3
	Diss. ortho-Phosphate	mg/L	0.11	0.08	0.08	0.11	0.04 J	0.14	0.14	0.07 J
Total Metals	Total Arsenic	ug/L	0.5 U	6.42	3.95	6.18	4.18	12.2	6.59	8.88
	Total Cadmium	ug/L	0.2 U	2.04	1.54	0.978	1.52	2 U	0.819	1.54
	Total Chromium	ug/L	4	33.1	24.8	19.3	18.8	25.3 J	13.1	22.8
	Total Copper	ug/L	30	80.6	60.4	41.6	43.9	79.6 J	31.8	68.4
	Total Iron	ug/L	1540	93400 J	50600		52200 J	29500 J	9740 J	27100
	Total Nickel	ug/L	3.8	30.8	19.7	16	10.8	25.6 J	9.86	28.9
	Total Lead	ug/L	4.5	98.6	62.9	28	34.3	47.3	17.4	56
	Total Zinc	ug/L	38.7	588	484	280	452 J	684	187 J	421 J
Dissolved Metals	Dissolved Arsenic	ug/L	0.5 U	0.5 U	1.1	2.25	1.74	5 U	4.84	3.51
	Dissolved Cadmium	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.25	2 U	0.2 U	0.2 U
	Dissolved Chromium	ug/L	2.5	2.11	3.08	1.83	11.6	10 UJ	4.4	3.22
	Dissolved Copper	ug/L	5.9	9.14	5.23	8.08	14.6	10.8 J	10.7	19.4
	Dissolved Iron	ug/L	114	8970 J	1050		1510 J	463 J	475 J	92.2
	Dissolved Nickel	ug/L	2 U	3.23	2.1	2	3.01	20 UJ	2.19	3.35
	Dissolved Lead	ug/L	1 U	1 U	1 U	1 U	3.64	10 U	1 U	1 U
	Dissolved Zinc	ug/L	9.4	25.8	19.2	12.6	76 J	283	21.7 J	51.3 J

J = Estimated concentration (in accordance with Caltrans EDD Checker)
U = Not detected at a concentration greater than the reporting limit shown.

Table B.3

Runoff Quality for Monitoring Site 3-203 (Echo Summit - #8)

		Sample End Date:	08/03/00	08/30/00	10/10/00	10/26/00	03/10/01	03/11/01	04/06/01	04/11/01
		Event ID:	2000-1	2000-2	2000-3	2000-4	2000-5	2000-6	2000-8	2000-9
		Unit of Measure								
Conventionals	pH	pH Units	6.34	5.61	6.25	7.02 J	7.03 J	6.83	6.68 J	7.22
	EC	umhos/cm	55	169	834	1250	5920	1900	3320	16200
	TSS	mg/L	263	25	64	88	170	239	796	920
	TDS	mg/L	43	220	453	670	2770	927	1920	8780
	Hardness as CaCO3	mg/L	6	20	28	96	82	66	90	144
	DOC	mg/L	18.5	65	13.8	9	4.7	4	25.5	13.5
	TOC	mg/L	21.7	80.5	16.7	12	4.5	4.2	28.5	14.5
	Turbidity	NTUs	138	66			652 J	673	587 J	675
	Chloride	mg/L	2.8	16		370	2100	510	960	5300
	Oil & Grease	mg/L	5 U	7						
Nutrients	Nitrate 3 (as N)	mg/L	0.66	1 J	0.3		0.29 J	0.24	0.47 J	0.15
	TKN	mg/L	4.8	4.8	1.5	0.9	0.3	0.4	0.8	0.8
	Total Phosphorus	mg/L	0.39	0.54	0.13	0.25	0.62	0.68	0.53 J	0.73 J
	Diss. ortho-Phosphate	mg/L	0.16	0.38	0.12	0.03 J	0.04 J	0.11	0.03 UJ	0.09
Total Metals	Total Arsenic	ug/L	1.8	2.15	0.7	2.3 J	5.39	5.38	3.48	9.18
	Total Cadmium	ug/L	0.78	0.27	0.34	0.569 J	0.2 UJ	0.391 J	0.881	2 U
	Total Chromium	ug/L	13.3	15.1	5.9	10.5	26.1 J	24.7 J	31.3	81.8 J
	Total Copper	ug/L	33.5	66.1	15.7	21.3 J	34.8 J	34.8 J	43.9	87.1 J
	Total Iron	ug/L	7290	2070		6350	10600 J	22600 J	41200 J	24400 J
	Total Nickel	ug/L	9.7	13.5	4.8	8.89	14.3 J	13.7 J	23	35.7 J
	Total Lead	ug/L	35.2	43	16.7	30.8	59.5	57.9	61.3	110
	Total Zinc	ug/L	103	198	131	174 J	214 J	270 J	240 J	623
Dissolved Metals	Dissolved Arsenic	ug/L	0.68	2.15	0.5 U	0.962 J	0.5 U	1.34	0.635	20.1
	Dissolved Cadmium	ug/L	0.2 U	0.27	0.27	0.266 J	0.2 UJ	0.2 UJ	0.2 U	2 U
	Dissolved Chromium	ug/L	2.7	5.85	1.3	1.75	2.43 J	1.93 J	4.31	10 UJ
	Dissolved Copper	ug/L	9	41.7	7.4	9.76 J	3.43 J	2.8 J	16.4	35.5 J
	Dissolved Iron	ug/L	179	497		389	263 J	365 J	766 J	41.2 J
	Dissolved Nickel	ug/L	2 U	10.2	3	3.66	2.83 J	2 UJ	6.97	13.7 J
	Dissolved Lead	ug/L	1 U	6.66	1 U	1.11	1.56	1 U	1.55	10.6
	Dissolved Zinc	ug/L	11.6	165	82.7	78.6 J	32.1 J	25.4 J	56.2 J	87.8

J = Estimated concentration (in accordance with Caltrans EDD Checker)
U = Not detected at a concentration greater than the reporting limit shown.

Table B.4

Precipitation Quality for Monitoring Site 3-202 (Tahoe Airport - #5)

		Sample End Date:	03/25/01		04/07/2001		04/12/2001		04/21/2001	
		Event ID:	2000-4		2000-5		2000-6		2000-8	
		Unit of Measure								
Conventionals	pH	pH Units			5.57		5.65	J	6.55	J
	EC	umhos/cm			11		82		18	
	TSS	mg/L	27		14		20		1	U
	TDS	mg/L	1	U	7		97		7	
	Hardness as CaCO3	mg/L					4		2	U
	DOC	mg/L					5.4		1	U
	TOC	mg/L					4.6		1	U
	Turbidity	NTUs					12	J		
	Chloride	mg/L	1	U	1.1		22		1.1	
	Oil & Grease	mg/L								
Nutrients	Nitrate 3 (as N)	mg/L	0.17		0.1	UJ	0.35	J	0.1	UJ
	TKN	mg/L					0.3		0.1	
	Total Phosphorus	mg/L					0.03	U	0.05	
	Diss. ortho-Phosphate	mg/L					0.03	UJ		
Total Metals	Total Arsenic	ug/L	0.5	U	0.5	U	0.5	U	2.39	
	Total Cadmium	ug/L	0.2	U	0.214		0.2	U	0.2	U
	Total Chromium	ug/L	3.16		1	U	1	U	4.21	
	Total Copper	ug/L	6.75		6.13		1.07		4.21	
	Total Iron	ug/L					617		967	
	Total Nickel	ug/L	3.02		2	U	2	U	2	U
	Total Lead	ug/L	2.49		3.2		1	U	1.7	
	Total Zinc	ug/L	196		65.1	J	22.2	J	50.1	J
Dissolved Metals	Dissolved Arsenic	ug/L	0.5	U	0.5	U	0.5	U	0.5	U
	Dissolved Cadmium	ug/L	0.2	U	0.2	U	0.2	U	0.2	U
	Dissolved Chromium	ug/L	1	U	1	U	1	U	1.6	
	Dissolved Copper	ug/L	1	U	5.7		3.7		1	U
	Dissolved Iron	ug/L					114		25	U
	Dissolved Nickel	ug/L	2	U	2	U	2	U	2	U
	Dissolved Lead	ug/L	1	U	1	U	1	U	1	U
	Dissolved Zinc	ug/L	65.4		49	J	46.4	J	44.7	J

J = Estimated concentration (in accordance with Caltrans EDD Checker)
U = Not detected at a concentration greater than the reporting limit shown.

Table B.5

Precipitation Quality Monitoring Site 3-203 (Echo Summit - #8)

		Sample End Date:	03/25/01	04/07/2001	04/12/2001	04/21/2001
		Event ID:	2000-7	2000-8	2000-9	2000-10
		Unit of Measure				
Conventionals	pH	pH Units		5.52	5.86 J	7.3 J
	EC	umhos/cm		5	11	174
	TSS	mg/L	1 U	7	3	2
	TDS	mg/L	1 U	1 U	43	73
	Hardness as CaCO3	mg/L			2 U	20
	DOC	mg/L			1.6	1.6
	TOC	mg/L			1	1 U
	Turbidity	NTUs			1.1 J	
	Chloride	mg/L	1 U	1 U	2	45
	Oil & Grease	mg/L				
Nutrients	Nitrate 3 (as N)	mg/L	0.2	0.1 UJ	0.14 J	0.1 UJ
	TKN	mg/L			0.1 U	0.8
	Total Phosphorus	mg/L			0.03 U	0.12
	Diss. ortho-Phosphate	mg/L			0.03 UJ	
Total Metals	Total Arsenic	ug/L	0.5 U	0.5 U	0.5 U	2.66
	Total Cadmium	ug/L	0.2 U	0.2 U	0.2 U	0.2 U
	Total Chromium	ug/L	20.3	1.04	13.7	4.88
	Total Copper	ug/L	2.88	6.61	10.8	14.9
	Total Iron	ug/L			171	2850
	Total Nickel	ug/L	2 U	2 U	2 U	13.9
	Total Lead	ug/L	1.14	2.37	2.62	4.25
	Total Zinc	ug/L	147	88.9 J	87.4 J	80.8 J
Dissolved Metals	Dissolved Arsenic	ug/L	0.5 U	0.5 U	0.5 U	0.5 U
	Dissolved Cadmium	ug/L	0.2 U	0.2 U	0.2 U	0.2 U
	Dissolved Chromium	ug/L	1 U	1 U	1 U	1 U
	Dissolved Copper	ug/L	1 U	6.86	2.55	1 U
	Dissolved Iron	ug/L			25 U	25 U
	Dissolved Nickel	ug/L	2 U	2 U	2 U	2 U
	Dissolved Lead	ug/L	1 U	1 U	1 U	1 U
	Dissolved Zinc	ug/L	54.3	47.2 J	70.7 J	40.4 J

J = Estimated concentration (in accordance with Caltrans EDD Checker)
U = Not detected at a concentration greater than the reporting limit shown.

Appendix C
Gravimetric Sediment Results

SEDIMENT CHARACTERIZATION STUDY

Location	Type	Position	Collection Period	Date Installed	Date Removed/ Sampled	Sample ID	Mass (g)
Echo Summit	Filter Box	#200	Period 1	1/29/01	2/28/01	200-1 (3/20/01)	384.8
Echo Summit	Filter Box	#400	Period 1	1/29/01	2/28/01	400-1 (3/20/01)	392.3
Echo Summit	Filter Box	#635	Period 1	1/29/01	2/28/01	635-1 (3/20/01)	435.1
Echo Summit	Filter Box	#200	Period 1	2/28/01	3/25/01	200-5 (3/25/01)	5961.5
Echo Summit	Filter Box	#400	Period 1	2/28/01	3/25/01	400-5 (3/25/01)	1663.6
Echo Summit	Filter Box	#635	Period 1	2/28/01	3/25/01	635-5 (3/25/01)	917.5
Echo Summit	Filter Box	#200	Period 2	3/25/01	5/2/01	200-5 (5/2/01)	2398
Echo Summit	Filter Box	#400	Period 2	3/25/01	5/2/01	400-5 (5/2/01)	1694
Echo Summit	Filter Box	#635	Period 2	3/25/01	5/2/01	635-5 (5/2/01)	982
Echo Summit	Sediment Trap	Upgradient	Period 1	1/29/01	3/25/01	--	
Echo Summit	Sediment Trap	Downgradient	Period 1	1/29/01	3/25/01	--	
Echo Summit	Sediment Trap	Upgradient	Period 2	4/2/01	5/2/01	Upgradient Bag (5/2/01)	52467
Echo Summit	Sediment Trap	Downgradient	Period 2	4/2/01	5/2/01	Downgradient Bag (5/2/01)	10254
Tahoe Airport	Filter Box	#200	Period 1	12/29/00	2/28/01	200-2 (3/20/01)	175.8
Tahoe Airport	Filter Box	#400	Period 1	12/29/00	2/28/01	400-2 (3/20/01)	364.6
Tahoe Airport	Filter Box	#635	Period 1	12/29/00	2/28/01	635-2 (3/20/01)	376.92
Tahoe Airport	Filter Box	#200	Period 1	2/28/01	4/4/01	200-5 (4/4/01)	1937
Tahoe Airport	Filter Box	#400	Period 1	2/28/01	4/4/01	400-5 (4/4/01)	1038
Tahoe Airport	Filter Box	#635	Period 1	2/28/01	4/4/01	635-5 (4/4/01)	546.3
Tahoe Airport	Filter Box	#200	Period 2	4/4/01	5/2/01	200-5 (5/2/01)	1392
Tahoe Airport	Filter Box	#400	Period 2	4/4/01	5/2/01	400-5 (5/2/01)	728.6
Tahoe Airport	Filter Box	#635	Period 2	4/4/01	5/2/01	635-5 (5/2/01)	572.3
Tahoe Airport	Sediment Trap	Upgradient	Period 1	12/29/01	4/2/01	Upgradient Bag (4/4/01)	72072
Tahoe Airport	Sediment Trap	Downgradient	Period 1	12/29/01	4/2/01	Downgradient Bag (4/4/01)	16088
Tahoe Airport	Sediment Trap	Upgradient	Period 2	4/2/01	5/2/01	Upgradient Bag (5/2/01)	7526
Tahoe Airport	Sediment Trap	Downgradient	Period 2	4/2/01	5/2/01	Downgradient Bag (5/2/01)	8923
Zinfandel	Filter Box	#200	Period 1	12/29/00	1/10/01	200-3 (3/02/01)	5281
Zinfandel	Filter Box	#400	Period 1	12/29/00	1/10/01	400-3(3/02/01)	923.4
Zinfandel	Filter Box	#635	Period 1	12/29/00	1/10/01	635-3(3/02/01)	352.6
Zinfandel	Filter Box	#200	Period 2	3/22/01	3/27/01	200-7 (3/27/01)	2144
Zinfandel	Filter Box	#400	Period 2	3/22/01	3/27/01	400-7 (3/27/01)	279.3
Zinfandel	Filter Box	#400	Period 3	4/4/01	4/9/01	400-1 (4/9/01)	3109
Zinfandel	Filter Box	#635	Period 3	4/4/01	4/9/01	635-tray (4/9/01)	148
Zinfandel	Filter Box	Pipe	Period 3	4/4/01	4/9/01	635-cleanout	3206
Highway 89	Sediment Trap	Upgradient	--	--	--	Hwy. 89 Upgradient	42616
Highway 89	Sediment Trap	Downgradient	--	--	--	Hwy. 89 Downgradient	4206.1
Highway 89	Filter Disk	Trap	--	--	--	Hwy. 89 #8	8.49
Highway 89	Filter Disk	Trap	--	--	--	Hwy. 89 #7	0.79

SEDIMENT CHARACTERIZATION STUDY

Location	Type	Position	Collection Period	Notes
Echo Summit	Filter Box	#200	Period 1	
Echo Summit	Filter Box	#400	Period 1	
Echo Summit	Filter Box	#635	Period 1	
Echo Summit	Filter Box	#200	Period 1	
Echo Summit	Filter Box	#400	Period 1	
Echo Summit	Filter Box	#635	Period 1	
Echo Summit	Filter Box	#200	Period 2	
Echo Summit	Filter Box	#400	Period 2	
Echo Summit	Filter Box	#635	Period 2	
Echo Summit	Sediment Trap	Upgradient	Period 1	Depth of sediment measured 3/25. Cleaned out by Caltrans 3/26 - 3/29.
Echo Summit	Sediment Trap	Downgradient	Period 1	Depth of sediment measured 3/25. Cleaned out by Caltrans 3/26 - 3/29.
Echo Summit	Sediment Trap	Upgradient	Period 2	
Echo Summit	Sediment Trap	Downgradient	Period 2	
Tahoe Airport	Filter Box	#200	Period 1	
Tahoe Airport	Filter Box	#400	Period 1	
Tahoe Airport	Filter Box	#635	Period 1	
Tahoe Airport	Filter Box	#200	Period 1	
Tahoe Airport	Filter Box	#400	Period 1	
Tahoe Airport	Filter Box	#635	Period 1	
Tahoe Airport	Filter Box	#200	Period 2	
Tahoe Airport	Filter Box	#400	Period 2	
Tahoe Airport	Filter Box	#635	Period 2	
Tahoe Airport	Sediment Trap	Upgradient	Period 1	
Tahoe Airport	Sediment Trap	Downgradient	Period 1	
Tahoe Airport	Sediment Trap	Upgradient	Period 2	
Tahoe Airport	Sediment Trap	Downgradient	Period 2	
Zinfandel	Filter Box	#200	Period 1	
Zinfandel	Filter Box	#400	Period 1	
Zinfandel	Filter Box	#635	Period 1	
Zinfandel	Filter Box	#200	Period 2	
Zinfandel	Filter Box	#400	Period 2	
Zinfandel	Filter Box	#400	Period 3	
Zinfandel	Filter Box	#635	Period 3	
Zinfandel	Filter Box	Pipe	Period 3	Sediment removed from pipe leading to filter box.
Highway 89	Sediment Trap	Upgradient	--	For particle size only to replace Echo summit cleanout.
Highway 89	Sediment Trap	Downgradient	--	For particle size only to replace Echo summit cleanout.
Highway 89	Filter Disk	Trap	--	For particle size only to replace Echo summit cleanout.
Highway 89	Filter Disk	Trap	--	For particle size only to replace Echo summit cleanout.

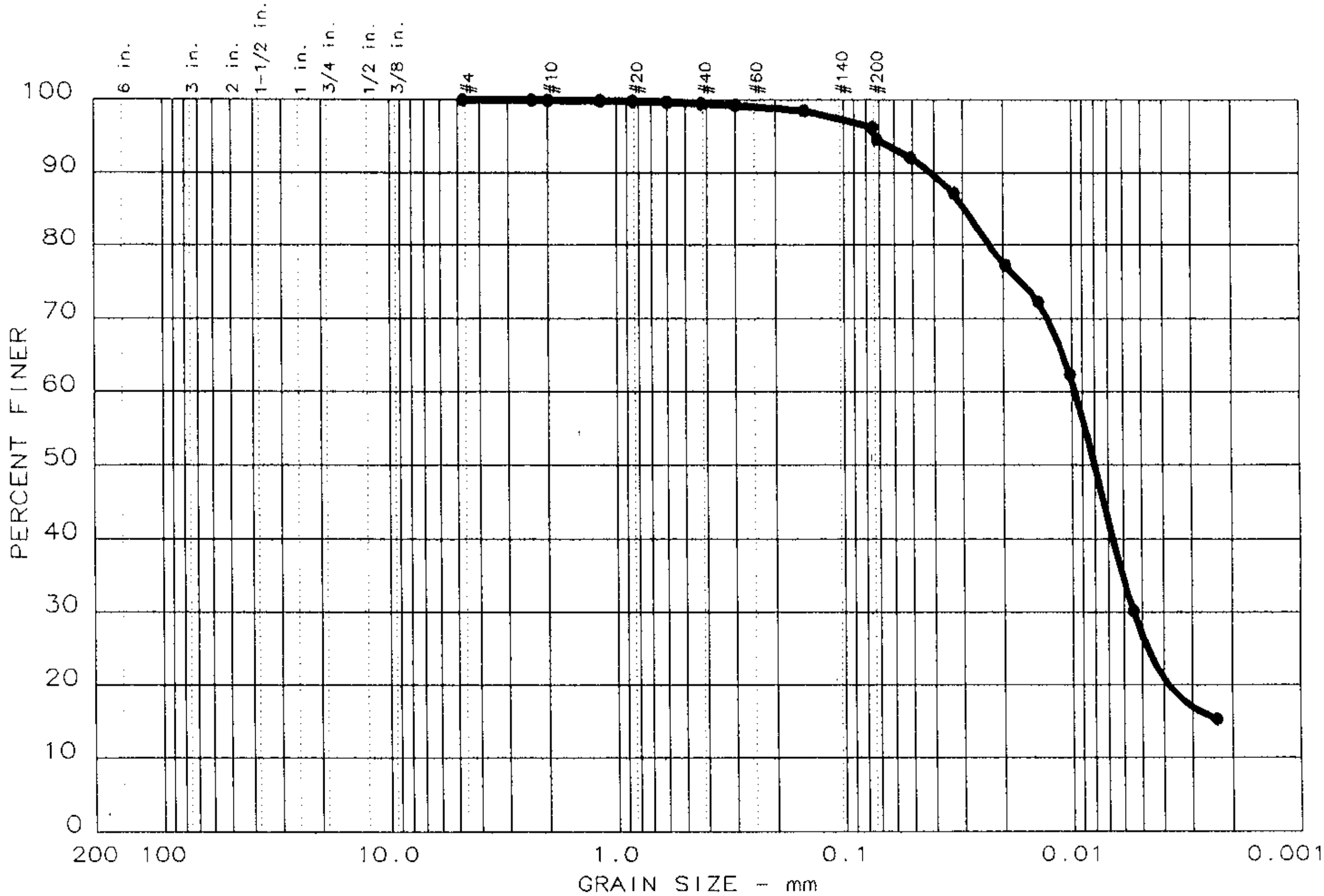
AUTOSAMPLER EFFECTIVENESS STUDY

Location	Sample Type	Method	Increment	Date Sampled	Period	Sample ID	Volume of Water (filter disk only) (liters)	Mass (g)
Echo Summit	Filter Discs	Autosampler	1	3/14/01	Period 1	EA1-031401 (2)	10	235.6
Echo Summit	Filter Discs	Autosampler	2	3/14/01	Period 1	EA2-031401 (2)	10	155.6
Echo Summit	Filter Discs	Manual Bucket	1	3/14/01	Period 1	EM1-031401	10	52.8
Echo Summit	Filter Discs	Manual Bucket	2	3/14/01	Period 1	EM2-031401	10	45.3
Echo Summit	Filter Discs	Autosampler	1	4/10/01	Period 2	EA1-041001	10	22.73
Echo Summit	Filter Discs	Manual Bucket	1	4/10/01	Period 2	EM1-041001	10	26.69
Echo Summit	Filter Discs	Autosampler	1	4/20/01	Period 3	EA1,2,3-042001	10	1.56
Echo Summit	Filter Discs	Manual Bucket	1	4/20/01	Period 3	EM1,2,3-042001	10	1.37
Zinfandel	Filter Discs	Autosampler	1	2/19/01	Period 1	ZA1-021001	10	0.62
Zinfandel	Filter Discs	Manual Bucket	1	2/19/01	Period 1	ZM1-021901	10	0.72
Zinfandel	Filter Discs	Manual Bucket	2	2/19/01	Period 1	ZM2-021901	10	2.76
Zinfandel	Filter Discs	Autosampler	1	2/24/01	Period 2	ZA1-022401	10	0.39
Zinfandel	Filter Discs	Manual Bucket	1	2/24/01	Period 2	ZM1-022401	10	0.47
Zinfandel	Filter Discs	Manual Bucket	2	2/24/01	Period 2	ZM2-022401	10	0.51
Zinfandel	Filter Discs	Autosampler	1	3/4/01	Period 3	ZA1-030401	10	1.2
Zinfandel	Filter Discs	Autosampler	2	3/4/01	Period 3	ZA2-030401	10	0.76
Zinfandel	Filter Discs	Manual Bucket	1	3/4/01	Period 3	ZM1-030401	10	1.04
Zinfandel	Filter Discs	Manual Bucket	2	3/4/01	Period 3	ZM2-030401	10	0.49
Zinfandel	Filter Discs	Manual Bucket	1	4/20/01	Period 4	ZM1,2,3-042001	10	1.46
Zinfandel	Filter Discs	Autosampler	1	4/20/01	Period 4	ZA1,2,3-042001	10	1.29

Appendix D
Grain Size Analysis Results

Appendix D-1
Grain Size Analysis
Sieve and Hydrometer Results

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	3.7	69.5	26.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.0080	0.0054				

MATERIAL DESCRIPTION	USCS	AASHTO
● Filter Cloth		

Project No.: 65880.01
Project: CDM
● Location: Echo Summit 3/20/01

Date: 04-12-01

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 20

Date: 04-12-01
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Echo Summit
Sample Description: Filter Cloth
USCS Class:
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	171.69
Tare =	0.00
Dry sample weight =	171.69

Sample split on number 10 sieve
Split sample data:
Sample and tare = 68.26 Tare = 0 Sample weight = 68.26
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 8	0.05	100.0
# 10	0.09	99.9
# 16	0.05	99.9
# 20	0.10	99.8
# 30	0.18	99.7
# 40	0.30	99.5
# 50	0.46	99.3
# 100	0.95	98.6
# 200	2.49	96.3

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 96.3
Weight of hydrometer sample: 68.26
Calculated biased weight= 70.88
Automatic temperature correction
Composite correction at 20 deg C =-5

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 20

Date: 04-12-01
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Echo Summit
Sample Description: Filter Cloth
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Meniscus correction only=-1
Specific gravity of solids= 1.549
Specific gravity correction factor= 1.757
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

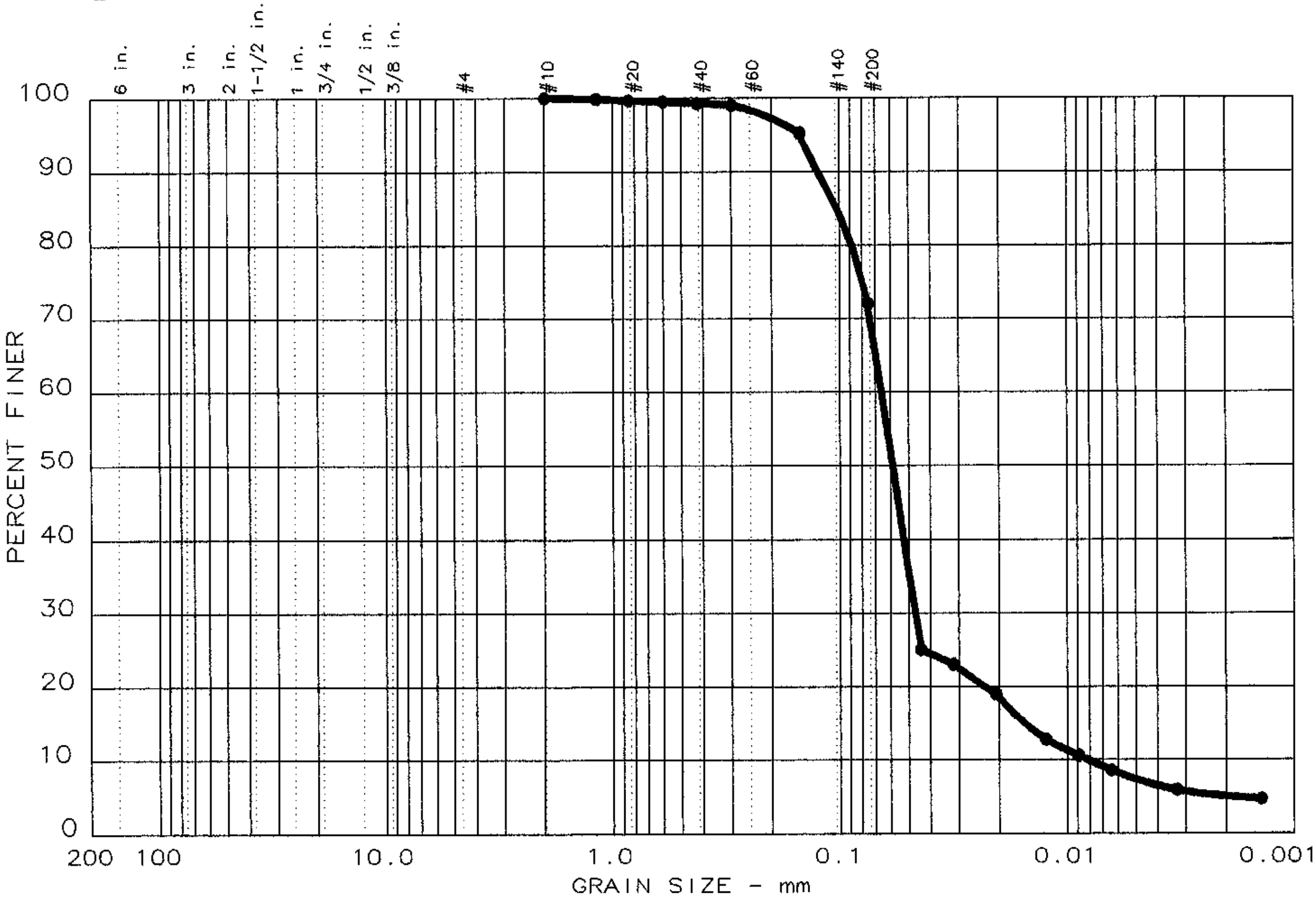
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.0	43.0	38.2	0.0233	42.0	9.4	0.0716	94.6
2.0	21.0	42.0	37.2	0.0233	41.0	9.6	0.0510	92.1
5.0	21.0	40.0	35.2	0.0233	39.0	9.9	0.0328	87.2
15.0	21.0	36.0	31.2	0.0233	35.0	10.6	0.0196	77.3
30.0	21.0	34.0	29.2	0.0233	33.0	10.9	0.0141	72.3
60.0	21.0	30.0	25.2	0.0233	29.0	11.5	0.0102	62.4
250.0	21.0	17.0	12.2	0.0233	16.0	13.7	0.0055	30.2
1440.0	21.1	11.0	6.2	0.0233	10.0	14.7	0.0024	15.4

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 3.7
% SILT = 69.5 % CLAY = 26.8

D85= 0.03 D60= 0.010 D50= 0.008
D30= 0.0054

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	27.9	64.8	7.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.102		0.0585	0.0468	0.0153	0.0080	4.21	8.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Echo Summit 3.~~27~~.01 25		

Project No.: 65880.01
Project: CDM Tahoe Basin
● Location: Echo Summit 3.~~27~~.01
25

Date: 04-30-01

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 13

Date: 04-30-01
Project No.: 65880.01
Project: CDM Tahoe Basin

Sample Data

Location of Sample: Echo Summit 3.27.01
Sample Description: Echo Summit 3.27.01
USCS Class:
Liquid limit:
AASHTO Class:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	70.10
Tare =	0.00
Dry sample weight =	70.10

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 16	0.10	99.9
# 20	0.25	99.6
# 30	0.37	99.5
# 40	0.53	99.2
# 50	0.72	99.0
# 100	3.36	95.2
# 200	19.58	72.1

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 72.1
Weight of hydrometer sample: 70.1
Calculated biased weight= 97.27
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.697
Specific gravity correction factor= 0.990
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

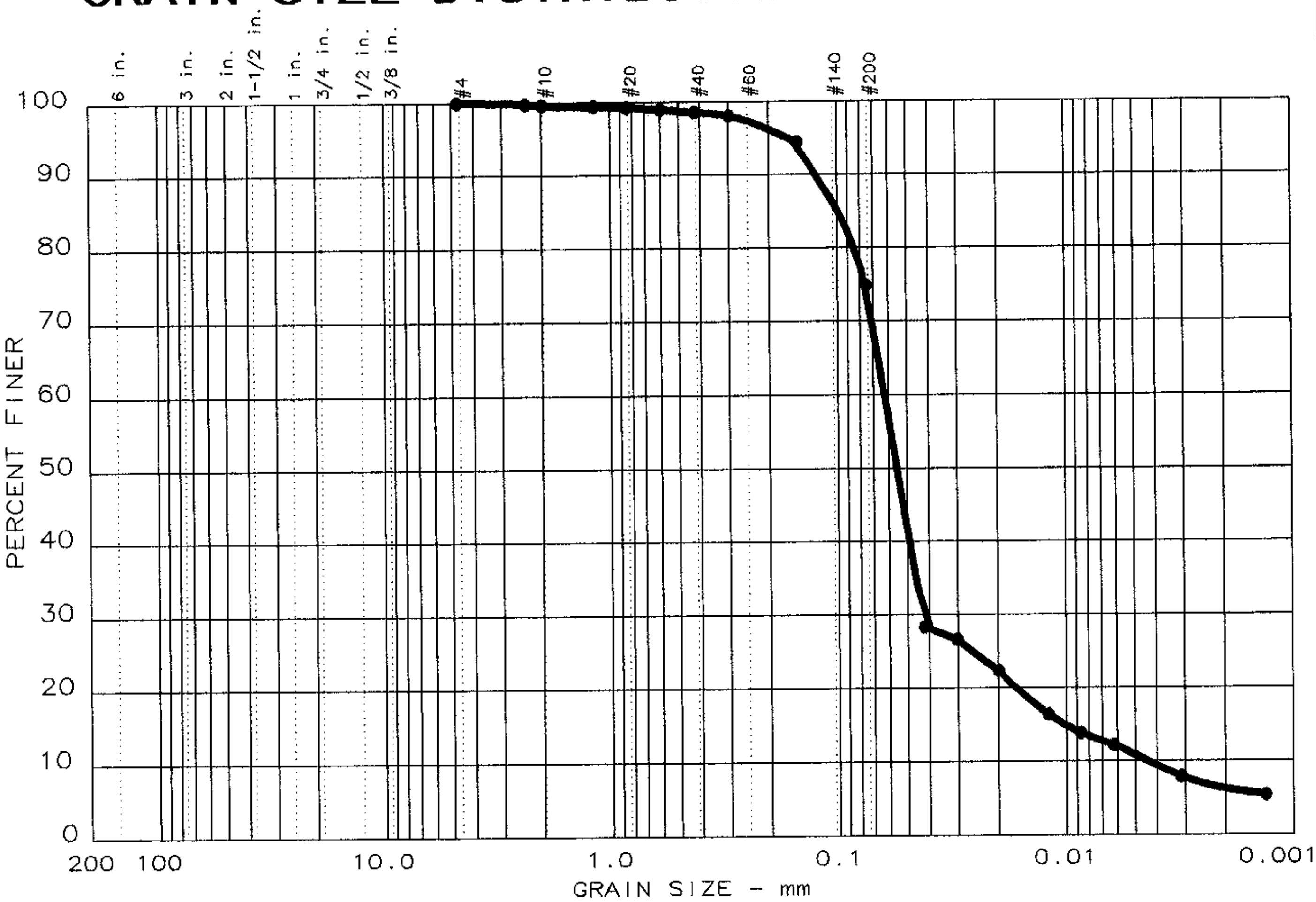
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.0	29.0	24.7	0.0130	28.0	11.7	0.0444	25.1
2.0	23.0	27.0	22.7	0.0130	26.0	12.0	0.0318	23.1
5.0	23.0	23.0	18.7	0.0130	22.0	12.7	0.0207	19.0
15.0	22.5	17.0	12.5	0.0130	16.0	13.7	0.0125	12.8
30.0	22.0	15.0	10.4	0.0131	14.0	14.0	0.0090	10.6
60.0	22.0	13.0	8.4	0.0131	12.0	14.3	0.0064	8.6
250.0	19.0	11.0	5.8	0.0136	10.0	14.7	0.0033	5.9
1440.0	18.0	10.0	4.5	0.0138	9.0	14.8	0.0014	4.6

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 27.9
% SILT = 64.8 % CLAY = 7.3

D85= 0.10 D60= 0.065 D50= 0.059
D30= 0.0468 D15= 0.01533 D10= 0.00795
Cc = 4.2121 Cu = 8.2319

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	25.1	64.0	10.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.0989		0.0551	0.0431	0.0102	0.0044	6.82	14.3

MATERIAL DESCRIPTION	USCS	AASHTO
● Echo Summit 050201		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.11.2001

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 20

Date: 06.11.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Echo Summit 050201
USCS Class:
Liquid limit:
AASHTO Class:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	87.52
Tare =	0.00
Dry sample weight =	87.52

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 8	0.22	99.7
# 10	0.35	99.6
# 16	0.51	99.4
# 20	0.65	99.3
# 30	0.92	98.9
# 40	1.26	98.6
# 50	1.70	98.1
# 100	4.83	94.5
# 200	22.00	74.9

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 74.9
Weight of hydrometer sample: 87.17
Calculated biased weight= 116.44
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.697

Specific gravity correction factor= 0.990
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.6	38.0	33.3	0.0132	37.0	10.2	0.0422	28.3
2.0	21.6	36.0	31.3	0.0132	35.0	10.6	0.0303	26.6
5.0	21.6	31.0	26.3	0.0132	30.0	11.4	0.0199	22.4
15.0	21.6	24.0	19.3	0.0132	23.0	12.5	0.0121	16.4
30.0	21.6	21.0	16.3	0.0132	20.0	13.0	0.0087	13.9
60.0	21.6	19.0	14.3	0.0132	18.0	13.3	0.0062	12.2
250.0	21.6	14.0	9.3	0.0132	13.0	14.2	0.0031	7.9
1440.0	21.6	11.0	6.3	0.0132	10.0	14.7	0.0013	5.4

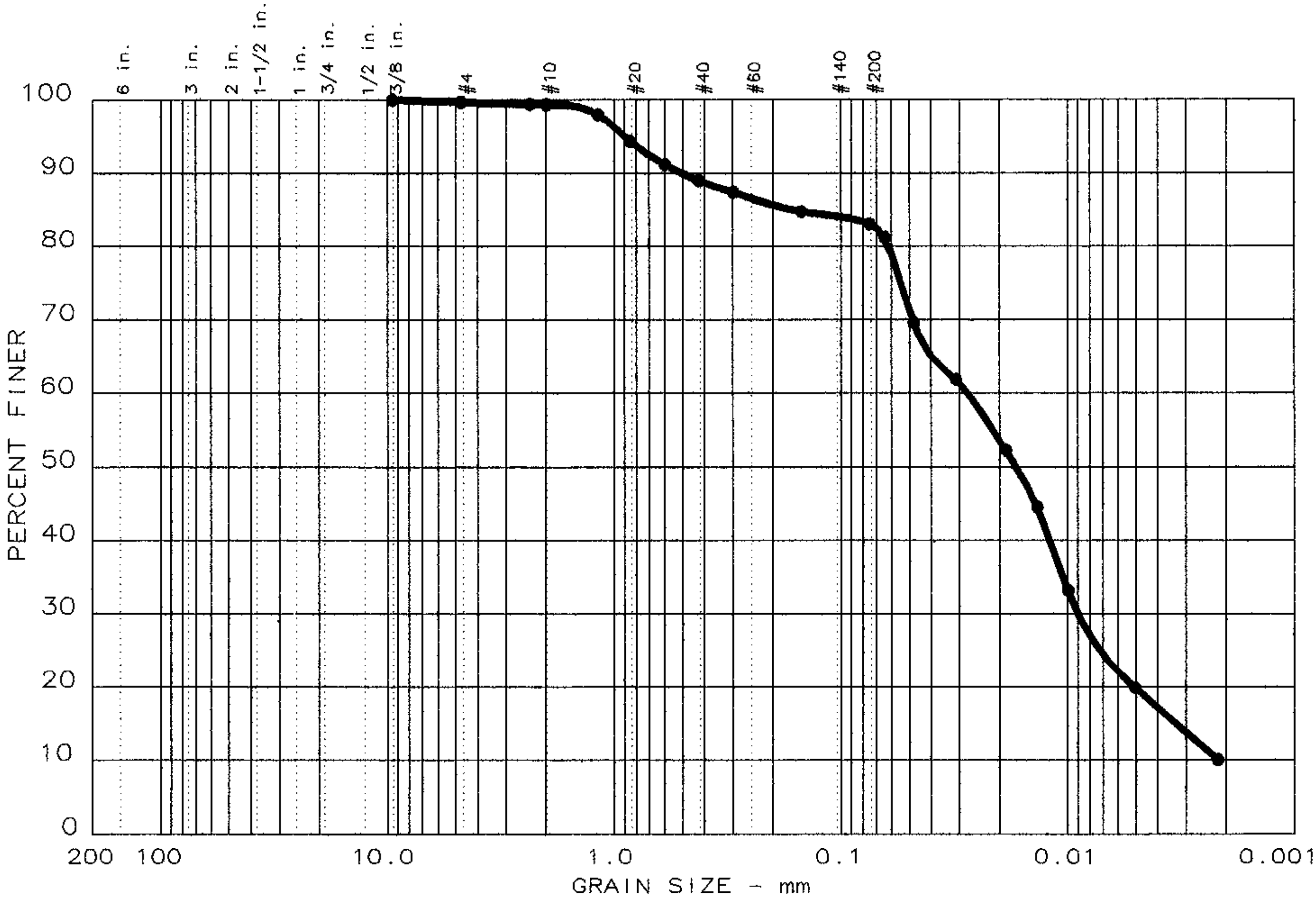
Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 0.0   % SAND = 25.1
% SILT = 64.0   % CLAY = 10.9

D85= 0.10 D60= 0.062 D50= 0.055
D30= 0.0431 D15= 0.01021 D10= 0.00436
Cc = 6.8234 Cu = 14.3219

ECha summit 050201

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.3	16.6	63.3	19.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.164		0.0168	0.0090	0.0033			

MATERIAL DESCRIPTION	USCS	AASHTO
● Filter Cloth		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Airport 3/20/01

Date: 04-12-01

GRAIN SIZE DISTRIBUTION TEST REPORT
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Remarks:
#4 Material is mostly foreign material

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 19

Date: 04-12-01
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Airport
Sample Description: Filter Cloth
USCS Class:
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks: #4 Material is mostly foreign material

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	133.03
Tare =	0.00
Dry sample weight =	133.03

Sample split on number 10 sieve
Split sample data:
Sample and tare = 68.28 Tare = 0 Sample weight = 68.28
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	0.40	99.7
# 8	0.79	99.4
# 10	0.84	99.4
# 16	0.97	98.0
# 20	3.43	94.4
# 30	5.61	91.2
# 40	7.11	89.0
# 50	8.22	87.4
# 100	10.04	84.8
# 200	11.21	83.1

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 83.1
Weight of hydrometer sample: 68.28
Calculated biased weight= 82.21
Automatic temperature correction

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 19

Date: 04-12-01
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Airport
Sample Description: Filter Cloth
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 1.645
Specific gravity correction factor= 1.588
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

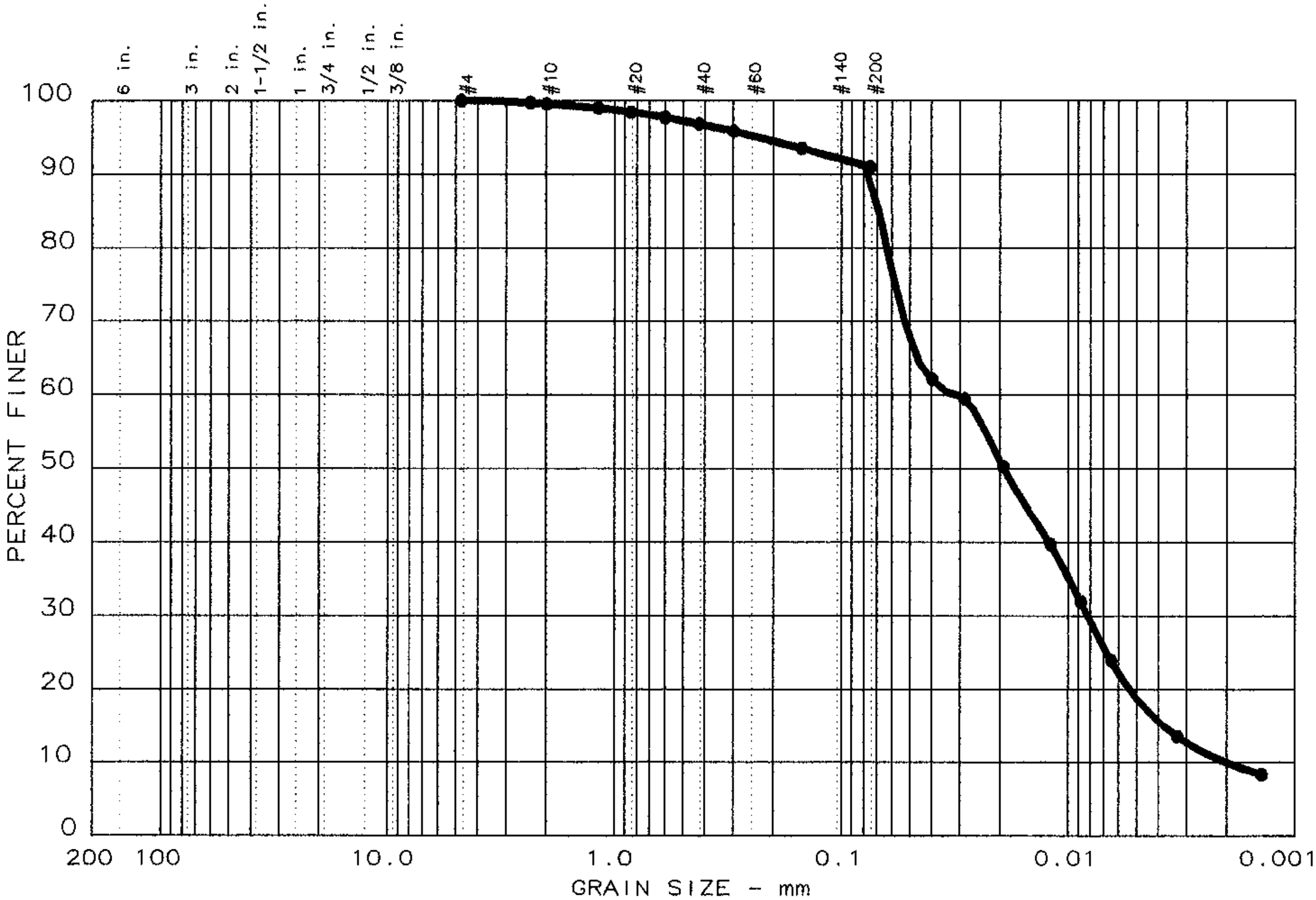
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.4	47.0	42.0	0.0217	46.0	8.8	0.0642	81.2
2.0	20.4	41.0	36.0	0.0217	40.0	9.7	0.0479	69.6
5.0	20.4	37.0	32.0	0.0217	36.0	10.4	0.0313	61.9
15.0	20.4	32.0	27.0	0.0217	31.0	11.2	0.0188	52.2
30.0	20.4	28.0	23.0	0.0217	27.0	11.9	0.0136	44.5
60.0	21.0	22.0	17.2	0.0215	21.0	12.9	0.0100	33.2
250.0	21.6	15.0	10.3	0.0214	14.0	14.0	0.0051	19.9
1440.0	21.2	10.0	5.2	0.0215	9.0	14.8	0.0022	10.1

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.3 % SAND = 16.6
% SILT = 63.3 % CLAY = 19.8

D85= 0.16 D60= 0.028 D50= 0.017
D30= 0.0090 D15= 0.00333

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	9.1	72.1	18.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●					0.0191	0.0082	0.0037	0.0020	1.12	15.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Tahoe Airport 4.0~~6~~.2001 4		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 05-09-01

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 2

Date: 05-09-01
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Tahoe Airport 4.06.2001
USCS Class:
Liquid limit:
AASHTO Class:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	71.48
Tare =	0.00
Dry sample weight =	71.48

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 8	0.21	99.7
# 10	0.33	99.5
# 16	0.75	99.0
# 20	1.15	98.4
# 30	1.69	97.6
# 40	2.31	96.8
# 50	2.99	95.8
# 100	4.66	93.5
# 200	6.48	90.9

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 90.9
Weight of hydrometer sample: 71.15
Calculated biased weight= 78.24
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.515

Specific gravity correction factor= 1.034
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

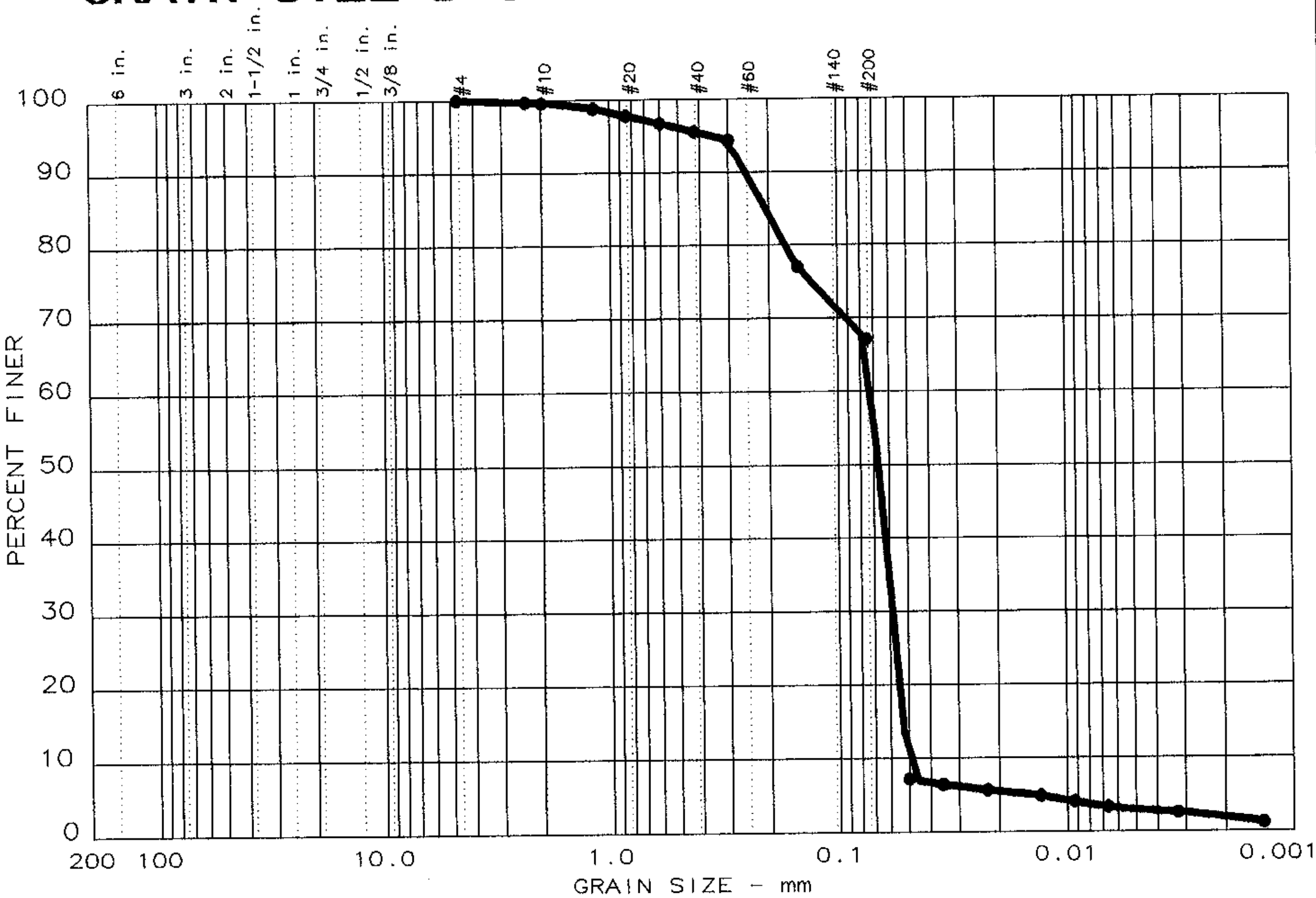
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.5	52.0	47.1	0.0142	51.0	7.9	0.0399	62.2
2.0	20.5	50.0	45.1	0.0142	49.0	8.3	0.0288	59.5
5.0	20.5	43.0	38.1	0.0142	42.0	9.4	0.0194	50.3
15.0	20.5	35.0	30.1	0.0142	34.0	10.7	0.0120	39.7
30.0	20.9	29.0	24.2	0.0141	28.0	11.7	0.0088	31.9
60.0	20.9	23.0	18.2	0.0141	22.0	12.7	0.0065	24.0
250.0	21.5	15.0	10.3	0.0140	14.0	14.0	0.0033	13.6
1440.0	21.6	11.0	6.3	0.0140	10.0	14.7	0.0014	8.3

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 0.0   % SAND = 9.1
% SILT = 72.1   % CLAY = 18.8

D85= 0.07 D60= 0.030 D50= 0.019
D30= 0.0082 D15= 0.00375 D10= 0.00199
Cc = 1.1181 Cu = 15.1880

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	32.9	64.2	2.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.206		0.0668	0.0583	0.0527	0.0509	0.93	1.4

MATERIAL DESCRIPTION	USCS	AASHTO
● Tahoe 050201		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.11.2001

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA   Test No.: 20

Date: 06.11.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Tahoe 050201
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	85.32
Tare =	0.00
Dry sample weight =	85.32

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 8	0.28	99.7
# 10	0.35	99.6
# 16	1.06	98.8
# 20	1.89	97.8
# 30	2.83	96.7
# 40	3.79	95.6
# 50	4.76	94.4
# 100	19.60	77.0
# 200	28.04	67.1

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 67.1
Weight of hydrometer sample: 84.97
Calculated biased weight= 126.56
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.687

Specific gravity correction factor= 0.992
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.3	14.0	9.2	0.0133	13.0	14.2	0.0500	7.2
2.0	21.3	13.0	8.2	0.0133	12.0	14.3	0.0355	6.5
5.0	21.3	12.0	7.2	0.0133	11.0	14.5	0.0226	5.7
15.0	21.3	11.0	6.2	0.0133	10.0	14.7	0.0131	4.9
30.0	21.3	10.0	5.2	0.0133	9.0	14.8	0.0093	4.1
60.0	21.3	9.0	4.2	0.0133	8.0	15.0	0.0066	3.3
250.0	21.3	8.0	3.2	0.0133	7.0	15.1	0.0033	2.5
1440.0	22.2	6.0	1.5	0.0131	5.0	15.5	0.0014	1.1

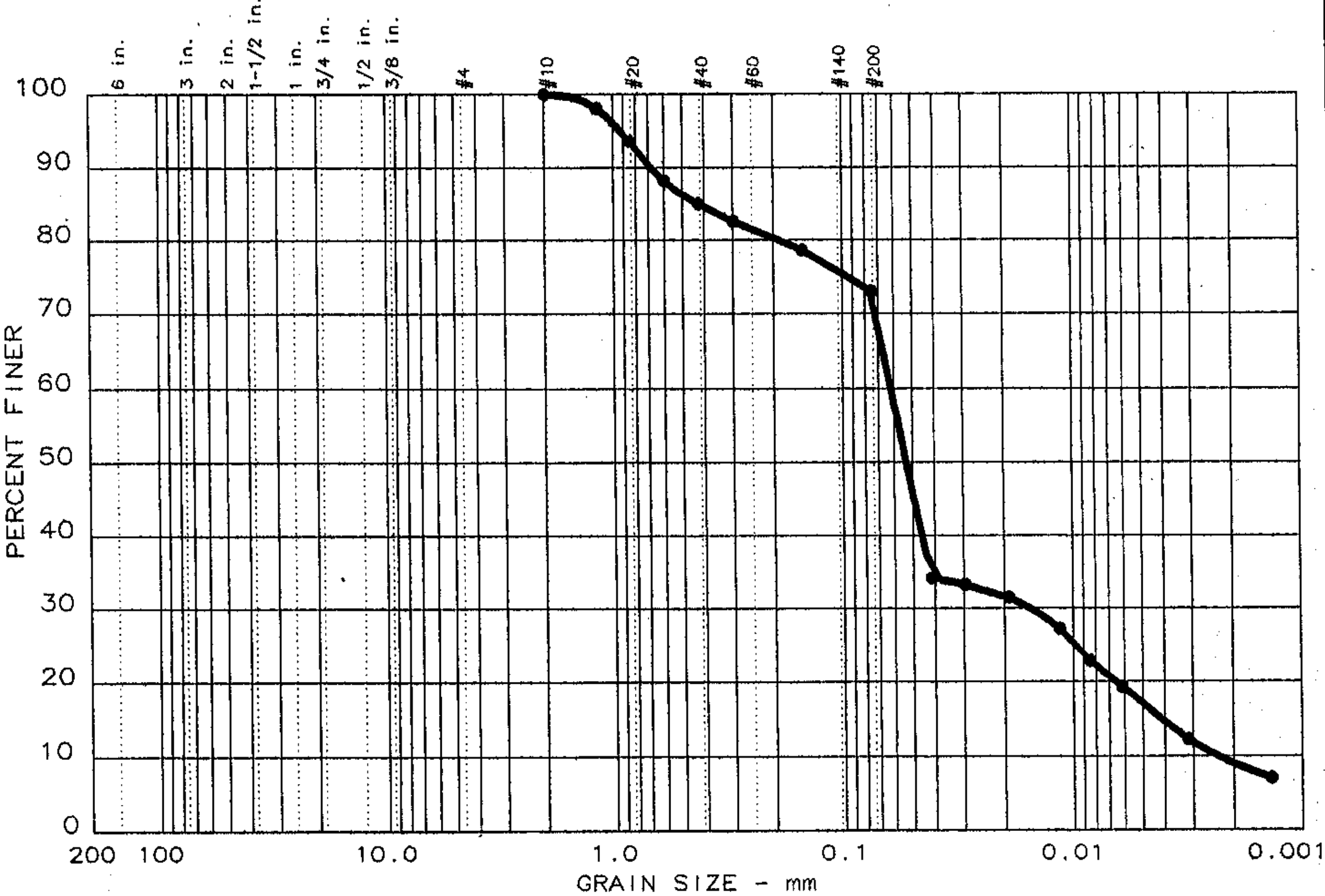
Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 0.0   % SAND = 32.9
% SILT = 64.2   % CLAY = 2.9

D85= 0.21   D60= 0.071   D50= 0.067
D30= 0.0583   D15= 0.05266   D10= 0.05087
Cc = 0.9343   Cu = 1.4044

Tahoe 050201

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	27.0	55.9	17.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.422		0.0530	0.0151	0.0041	0.0023	1.60	26.6

MATERIAL DESCRIPTION	USCS	AASHTO
● Tahoe Airport Down Gradient Can 04.~~12~~4.2001		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 05.21.2001

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 20

Date: 05.21.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Tahoe Airport Down Gradient Can 04.12.2001
USCS Class:
Liquid limit:
AASHTO Class:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	84.84
Tare =	0.00
Dry sample weight =	84.84

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 16	1.61	98.1
# 20	5.37	93.7
# 30	10.02	88.2
# 40	12.72	85.0
# 50	14.78	82.6
# 100	18.13	78.6
# 200	22.90	73.0

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 73.0
Weight of hydrometer sample: 84.84
Calculated biased weight= 116.21
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.592
Specific gravity correction factor= 1.014
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

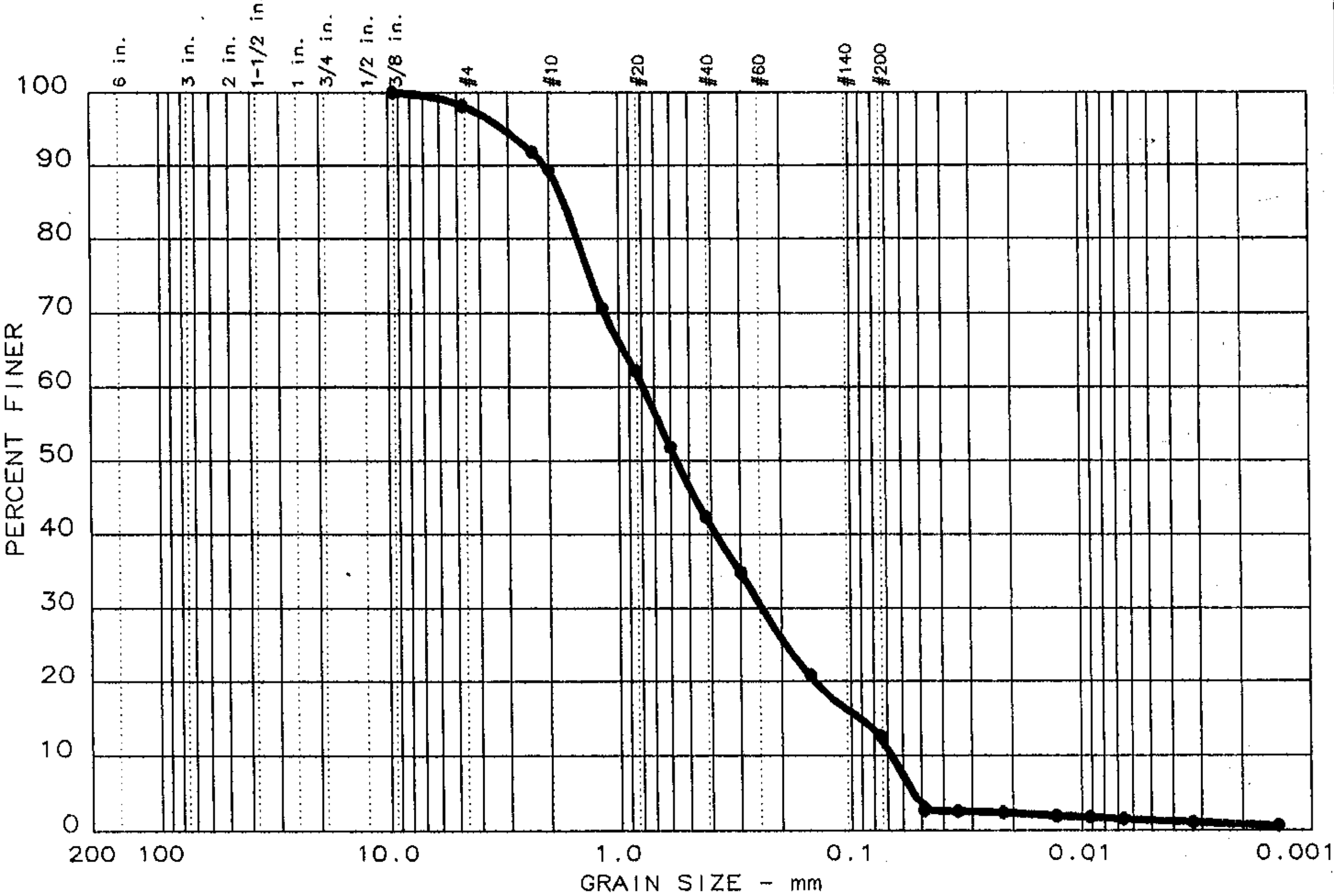
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.0	44.0	39.2	0.0137	43.0	9.2	0.0417	34.2
2.0	21.0	43.0	38.2	0.0137	42.0	9.4	0.0298	33.3
5.0	21.0	41.0	36.2	0.0137	40.0	9.7	0.0191	31.6
15.0	21.0	36.0	31.2	0.0137	35.0	10.6	0.0115	27.2
30.0	21.0	31.0	26.2	0.0137	30.0	11.4	0.0084	22.8
60.0	21.0	27.0	22.2	0.0137	26.0	12.0	0.0061	19.3
250.0	21.0	19.0	14.2	0.0137	18.0	13.3	0.0032	12.4
1440.0	20.8	13.0	8.1	0.0138	12.0	14.3	0.0014	7.1

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 27.0
% SILT = 55.9 % CLAY = 17.1

D85= 0.42 D60= 0.062 D50= 0.053
D30= 0.0151 D15= 0.00411 D10= 0.00231
Cc = 1.6014 Cu = 26.6379

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	1.8	85.5	11.3	1.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.72	0.783	0.564	0.241	0.0915	0.0668	1.11	11.7

MATERIAL DESCRIPTION	USCS	AASHTO
● Tahoe Airport Up Gradient Can 04 ~~12~~ 4 .2001		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 05.21.2001

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.594
Specific gravity correction factor= 1.013
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.0	23.0	18.2	0.0137	22.0	12.7	0.0488	2.7
2.0	21.0	22.0	17.2	0.0137	21.0	12.9	0.0348	2.6
5.0	21.0	21.0	16.2	0.0137	20.0	13.0	0.0221	2.4
15.0	21.0	18.0	13.2	0.0137	17.0	13.5	0.0130	2.0
30.0	21.0	17.0	12.2	0.0137	16.0	13.7	0.0093	1.8
60.0	21.0	15.0	10.2	0.0137	14.0	14.0	0.0066	1.5
250.0	21.0	12.0	7.2	0.0137	11.0	14.5	0.0033	1.1
1440.0	20.8	9.0	4.1	0.0137	8.0	15.0	0.0014	0.6

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 1.8 % SAND = 85.5
% SILT = 11.3 % CLAY = 1.4

D85= 1.72 D60= 0.783 D50= 0.564
D30= 0.2407 D15= 0.09152 D10= 0.06683
Cc = 1.1079 Cu = 11.7085

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 19

Date: 05.21.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Tahoe Airport Up Gradient Can 04.12.2001
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	95.37
Tare =	0.00
Dry sample weight =	95.37

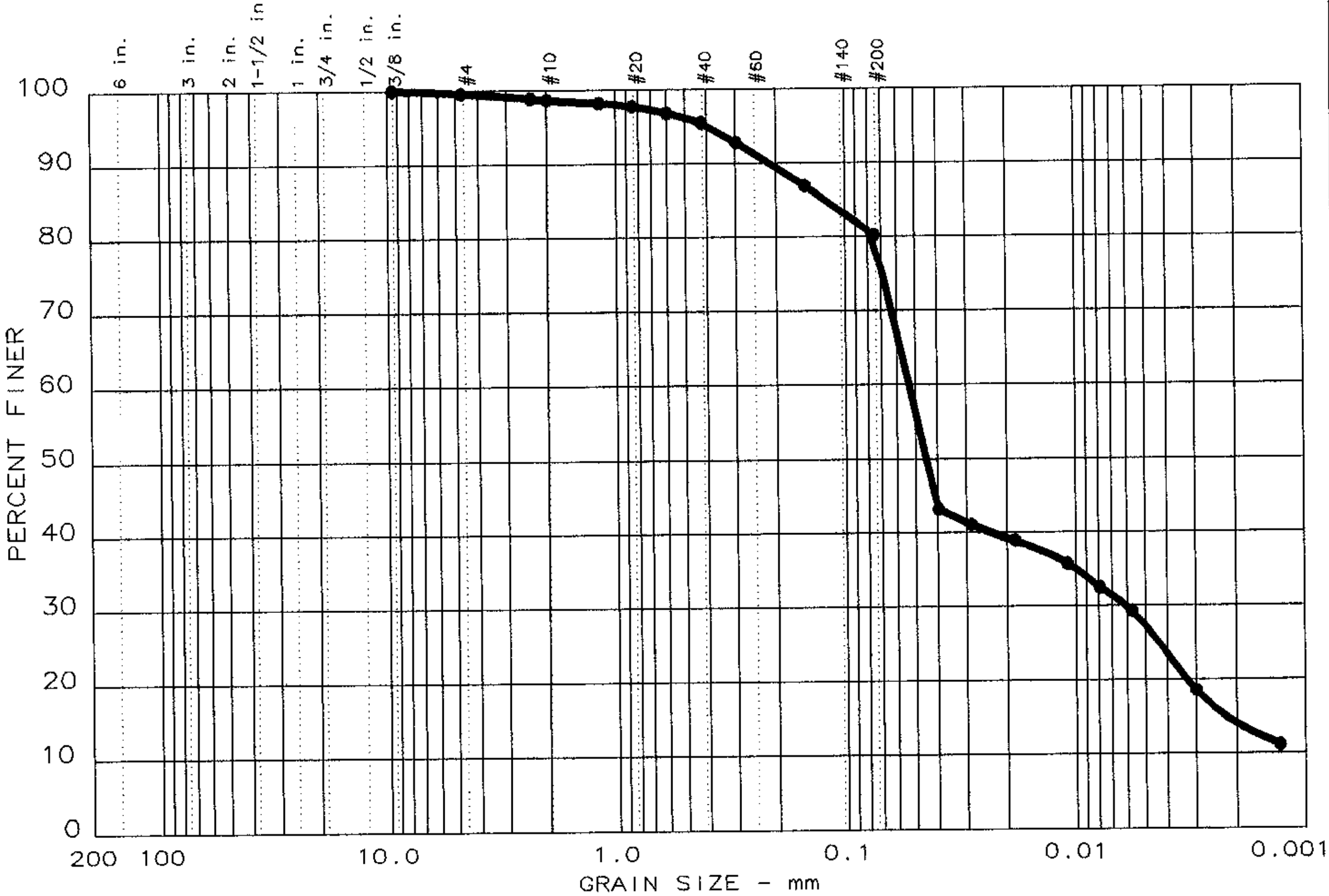
Sample split on number 10 sieve
Split sample data:
Sample and tare = 85.19 Tare = 0 Sample weight = 85.19
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	1.73	98.2
# 8	7.79	91.8
# 10	10.18	89.3
# 16	17.78	70.7
# 20	25.79	62.3
# 30	35.78	51.8
# 40	44.74	42.4
# 50	51.95	34.9
# 100	65.26	20.9
# 200	73.13	12.6

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 12.6
Weight of hydrometer sample: 85.19
Calculated biased weight= 673.68
Automatic temperature correction

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.4	19.4	52.9	27.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.122		0.0447	0.0060	0.0022			

MATERIAL DESCRIPTION	USCS	AASHTO
● Tahoe Downgradient 050201		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.11.2001

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA   Test No.: 20

Date: 06.11.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Tahoe Downgradient 050201
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 75.10
Tare = 0.00
Dry sample weight = 75.10
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	0.32	99.6
# 8	0.84	98.9
# 10	1.00	98.7
# 16	1.34	98.2
# 20	1.69	97.7
# 30	2.39	96.8
# 40	3.34	95.6
# 50	5.37	92.8
# 100	9.80	87.0
# 200	14.87	80.2

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 80.2
Weight of hydrometer sample: 74.1
Calculated biased weight= 92.39
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1

Specific gravity of solids= 2.691
Specific gravity correction factor= 0.991
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.5	45.0	40.3	0.0132	44.0	9.1	0.0399	43.2
2.0	21.5	43.0	38.3	0.0132	42.0	9.4	0.0287	41.1
5.0	21.5	41.0	36.3	0.0132	40.0	9.7	0.0185	38.9
15.0	21.5	38.0	33.3	0.0132	37.0	10.2	0.0109	35.7
30.0	21.5	35.0	30.3	0.0132	34.0	10.7	0.0079	32.5
60.0	21.5	32.0	27.3	0.0132	31.0	11.2	0.0057	29.3
250.0	21.5	22.0	17.3	0.0132	21.0	12.9	0.0030	18.5
1440.0	22.0	15.0	10.4	0.0132	14.0	14.0	0.0013	11.2

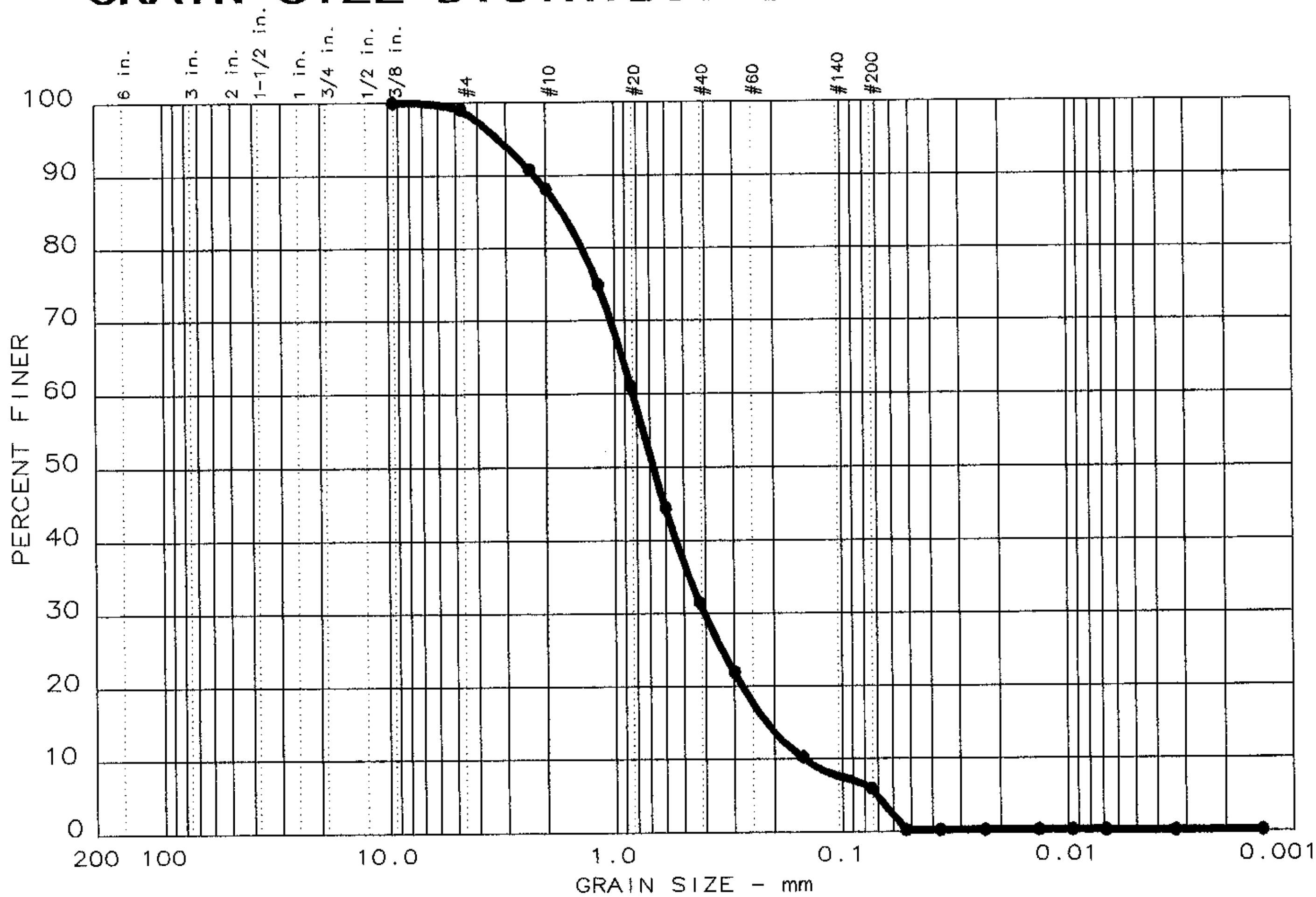
Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 0.4   % SAND = 19.4
% SILT = 52.9   % CLAY = 27.3

D85= 0.12 D60= 0.053 D50= 0.045
D30= 0.0060 D15= 0.00224

DownGradient 050201

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	1.0	93.2	5.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.68	0.831	0.675	0.406	0.215	0.146	1.36	5.7

MATERIAL DESCRIPTION	USCS	AASHTO
● Tahoe Upgradient 050201		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.11.2001

GRAIN SIZE DISTRIBUTION TEST REPORT
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Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA   Test No.: 20

Date: 06.11.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Tahoe Upgradient 050201
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	136.13
Tare =	0.00
Dry sample weight =	136.13

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	1.30	99.0
# 8	12.56	90.8
# 10	16.14	88.1
# 16	34.08	75.0
# 20	53.00	61.1
# 30	75.60	44.5
# 40	93.31	31.5
# 50	106.28	21.9
# 100	122.14	10.3
# 200	128.12	5.9

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 5.9
Weight of hydrometer sample: 119.99
Calculated biased weight= % 2039.230799
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1

Specific gravity of solids= 2.623
Specific gravity correction factor= 1.006
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.0	9.0	4.2	0.0136	8.0	15.0	0.0526	0.2
2.0	21.0	9.0	4.2	0.0136	8.0	15.0	0.0372	0.2
5.0	21.0	9.0	4.2	0.0136	8.0	15.0	0.0235	0.2
15.0	21.0	9.0	4.2	0.0136	8.0	15.0	0.0136	0.2
30.0	21.0	9.0	4.2	0.0136	8.0	15.0	0.0096	0.2
60.0	21.0	8.0	3.2	0.0136	7.0	15.1	0.0068	0.2
250.0	21.0	7.0	2.2	0.0136	6.0	15.3	0.0034	0.1
1440.0	22.0	7.0	2.4	0.0134	6.0	15.3	0.0014	0.1

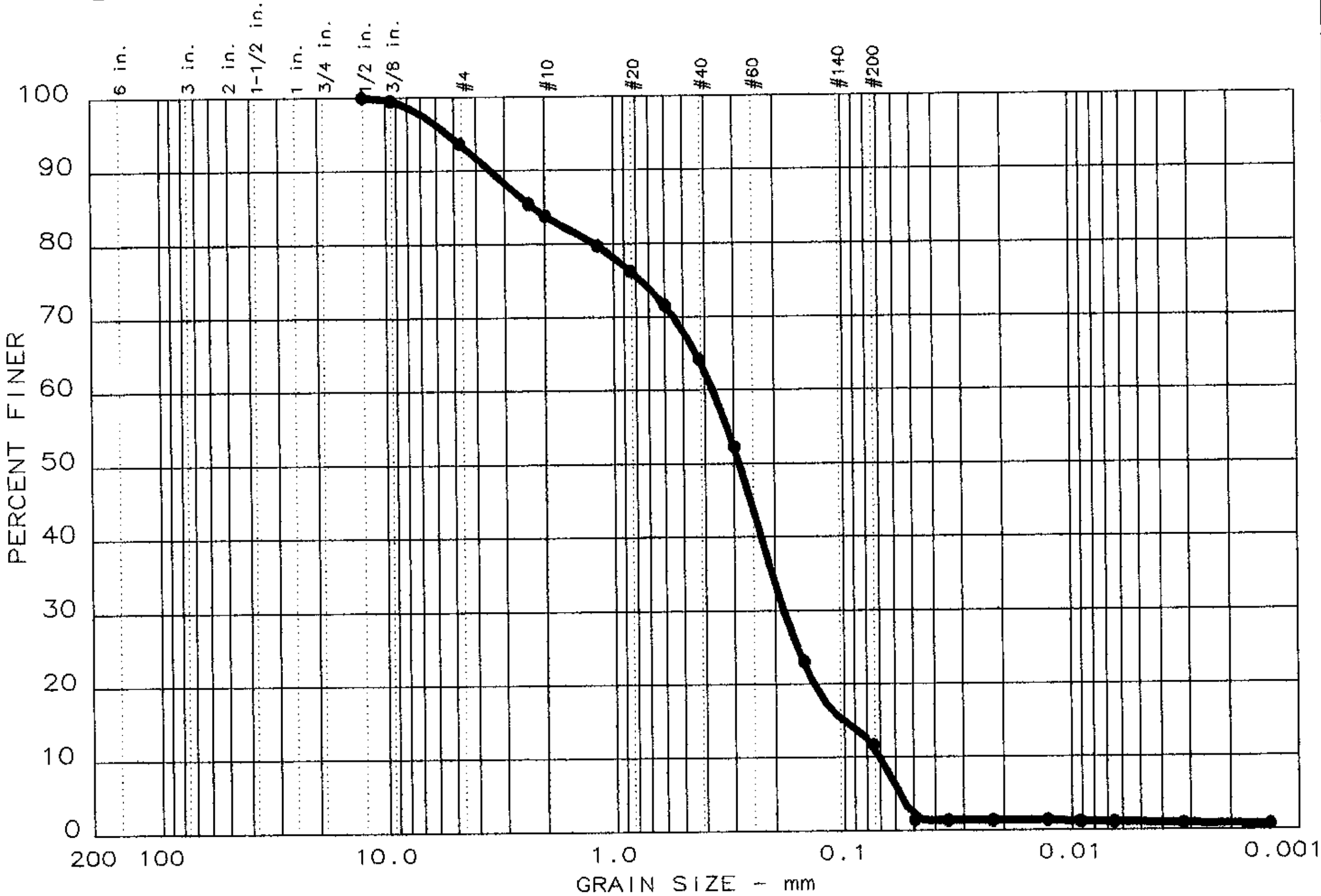
Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 1.0   % SAND = 93.2
% FINES = 5.8

D85= 1.68 D60= 0.831 D50= 0.675
D30= 0.4055 D15= 0.21528 D10= 0.14555
Cc = 1.3599 Cu = 5.7082

upgradient 050201

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	6.3	82.0	10.7	1.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			2.24	0.367	0.284	0.183	0.100	0.0701	1.30	5.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Sample#1 Traction Sand 3/02/01		

Project No.: 65880.01
Project: CDM Inc.
● Location: Tahoe Basin Rinfalel

Date: 03-15-01

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
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Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 6

Date: 03-15-01
Project No.: 65880.01
Project: CDM Inc.

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Sample#1 Traction Sand
USCS Class:
Liquid limit:
AASHTO Class:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare =	509.83
Tare =	0.00
Dry sample weight =	509.83

Sample split on number 10 sieve
Split sample data:
Sample and tare = 121.16 Tare = 0 Sample weight = 121.16
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.5 inches	0.00	100.0
0.375 inches	2.42	99.5
# 4	32.28	93.7
# 8	74.10	85.5
# 10	82.58	83.8
# 16	5.84	79.8
# 20	10.87	76.3
# 30	17.60	71.6
# 40	28.31	64.2
# 50	45.61	52.3
# 100	87.77	23.1
# 200	104.31	11.7

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 11.7
Weight of hydrometer sample: 121.16
Calculated biased weight= % 1039.58963272
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

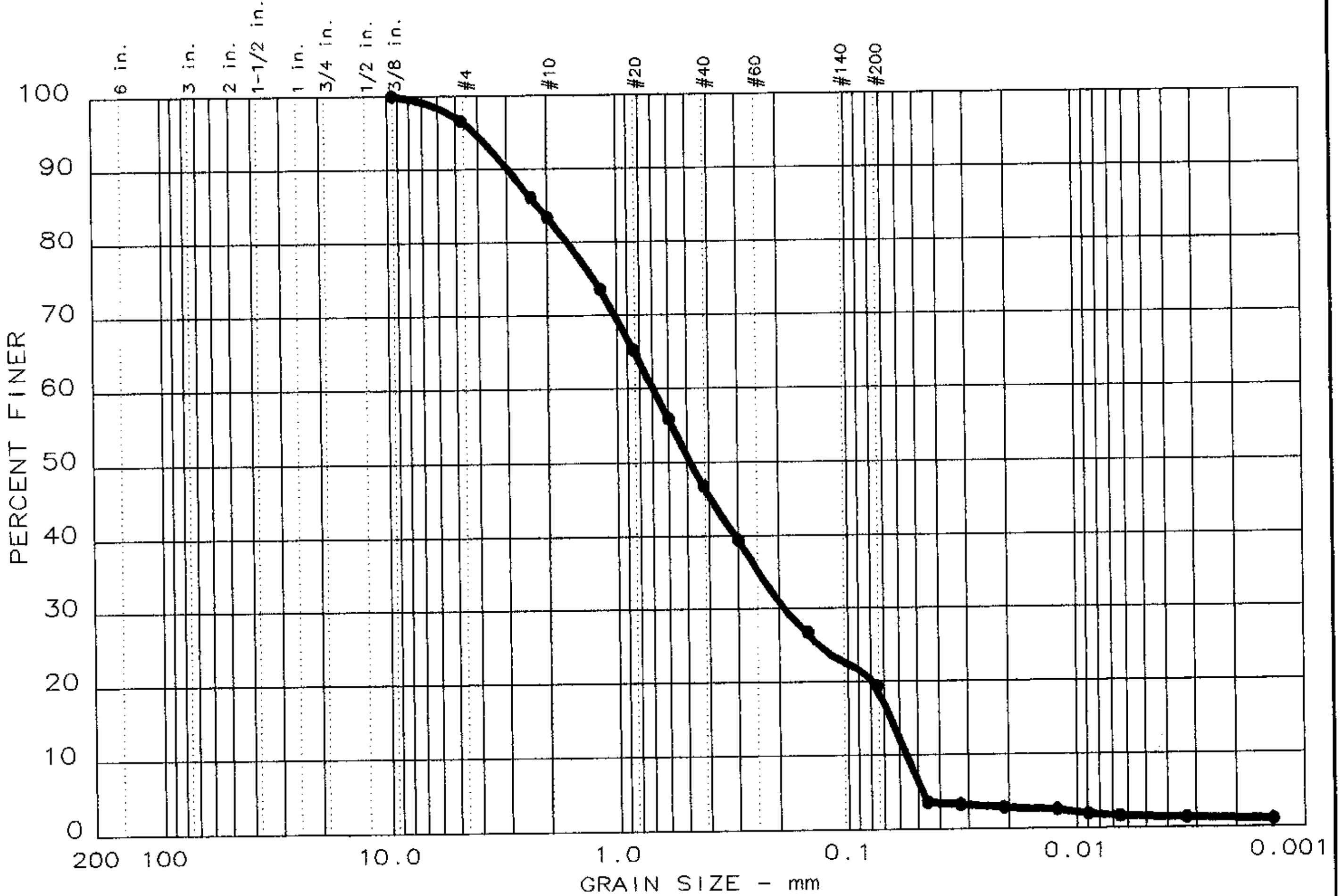
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	20.0	20.0	15.0	0.0136	19.0	13.2	0.0495	1.4
2.0	20.0	19.0	14.0	0.0136	18.0	13.3	0.0352	1.3
5.0	20.0	19.0	14.0	0.0136	18.0	13.3	0.0223	1.3
15.0	20.0	19.0	14.0	0.0136	18.0	13.3	0.0129	1.3
30.0	20.0	17.0	12.0	0.0136	16.0	13.7	0.0092	1.2
60.0	20.0	16.0	11.0	0.0136	15.0	13.8	0.0066	1.1
250.0	20.0	14.0	9.0	0.0136	13.0	14.2	0.0032	0.9
1440.0	21.1	12.0	7.2	0.0135	11.0	14.5	0.0014	0.7

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 6.3 % SAND = 82.0
% SILT = 10.7 % CLAY = 1.0

D85= 2.24 D60= 0.367 D50= 0.284
D30= 0.1828 D15= 0.10046 D10= 0.07006
Cc = 1.2987 Cu = 5.2420

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	3.4	77.2	17.9	1.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			2.19	0.692	0.479	0.188	0.0653	0.0556	0.92	12.4

MATERIAL DESCRIPTION	USCS	AASHTO
● Zinfandel 3.27.01		

Project No.: 65880.01
Project: CDM Tahoe Basin
● Location: Zinfandel 3.~~27~~.01
25

Date: 04-30-01

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
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Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 12

Date: 04-30-01
Project No.: 65880.01
Project: CDM Tahoe Basin

Sample Data

Location of Sample: Zinfandel
Sample Description: Zinfandel 3.27.01
USCS Class:
AASHTO Class:
Liquid limit:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	157.17
Tare =	0.00
Dry sample weight =	157.17

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	5.37	96.6
# 8	21.72	86.2
# 10	26.07	83.4
# 16	41.59	73.5
# 20	54.52	65.3
# 30	69.21	56.0
# 40	83.57	46.8
# 50	95.22	39.4
# 100	115.10	26.8
# 200	126.72	19.4

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 19.4
Weight of hydrometer sample: 131.1
Calculated biased weight= 676.68
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1

Specific gravity of solids= 2.615
Specific gravity correction factor= 1.008
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

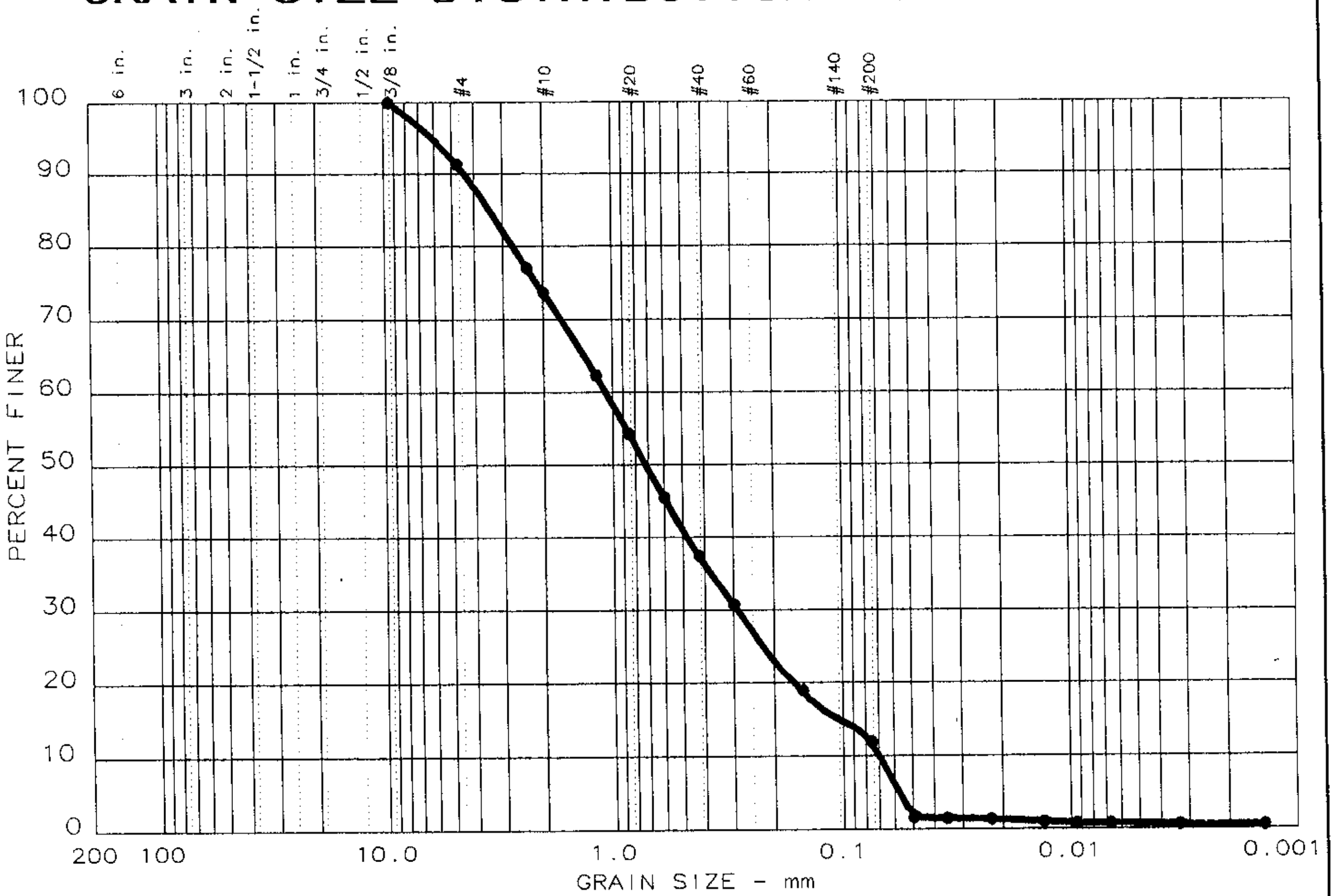
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	23.5	28.0	23.8	0.0132	27.0	11.9	0.0455	3.5
2.0	23.5	26.0	21.8	0.0132	25.0	12.2	0.0326	3.2
5.0	23.5	23.0	18.8	0.0132	22.0	12.7	0.0211	2.8
15.0	23.5	21.0	16.8	0.0132	20.0	13.0	0.0123	2.5
30.0	23.0	17.0	12.7	0.0133	16.0	13.7	0.0090	1.9
60.0	22.0	15.0	10.4	0.0135	14.0	14.0	0.0065	1.6
250.0	19.0	14.0	8.8	0.0140	13.0	14.2	0.0033	1.3
1440.0	20.0	12.0	7.0	0.0138	11.0	14.5	0.0014	1.0

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 3.4   % SAND = 77.2
% SILT = 17.9   % CLAY = 1.5

D85= 2.19 D60= 0.692 D50= 0.479
D30= 0.1884 D15= 0.06531 D10= 0.05559
Cc = 0.9226 Cu = 12.4451

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	8.7	79.4	11.2	0.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			3.42	1.07	0.718	0.286	0.104	0.0693	1.11	15.4

MATERIAL DESCRIPTION	USCS	AASHTO
● Zinfandel Fabric 04.~~12~~ 9.01		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Airport

Date: 05.23.2001

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
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Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 11

Date: 05.23.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Airport
Sample Description: Zinfandel Fabric 04.12.01
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	150.81
Tare =	0.00
Dry sample weight =	150.81

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	13.06	91.3
# 8	34.60	77.1
# 10	39.68	73.7
# 16	56.62	62.5
# 20	69.00	54.2
# 30	82.15	45.5
# 40	94.37	37.4
# 50	104.33	30.8
# 100	122.23	19.0
# 200	132.79	11.9

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 11.9
Weight of hydrometer sample: 111.13
Calculated biased weight= 930.05
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1

Specific gravity of solids= 2.562
Specific gravity correction factor= 1.021
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

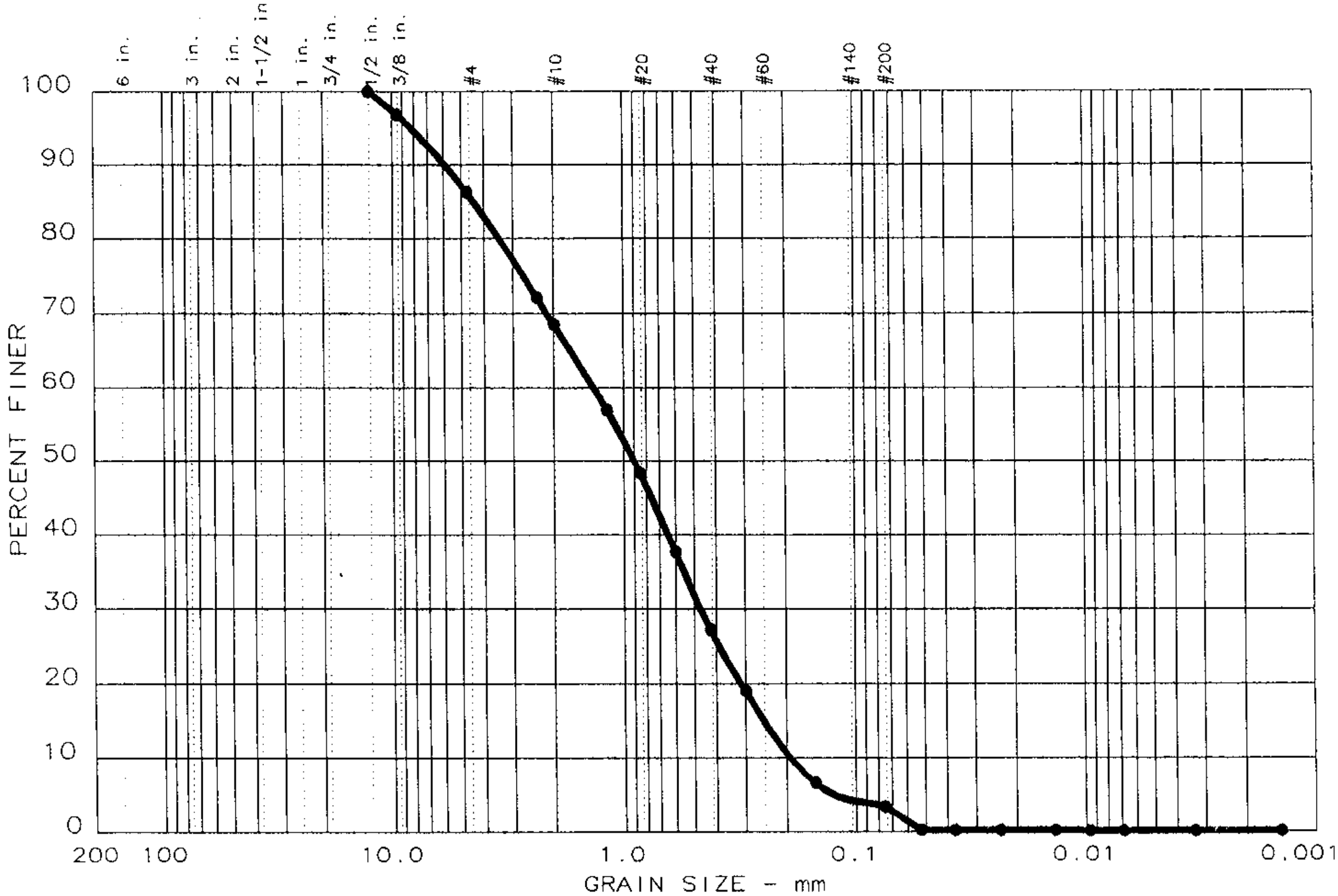
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.5	19.0	14.5	0.0136	18.0	13.3	0.0497	1.6
2.0	22.5	18.0	13.5	0.0136	17.0	13.5	0.0353	1.5
5.0	22.5	17.0	12.5	0.0136	16.0	13.7	0.0225	1.4
15.0	22.5	13.5	9.0	0.0136	12.5	14.2	0.0133	1.0
30.0	22.3	12.0	7.5	0.0136	11.0	14.5	0.0095	0.8
60.0	22.3	11.5	7.0	0.0136	10.5	14.6	0.0067	0.8
250.0	22.0	10.0	5.4	0.0137	9.0	14.8	0.0033	0.6
1440.0	21.0	9.5	4.7	0.0139	8.5	14.9	0.0014	0.5

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 8.7   % SAND = 79.4
% SILT = 11.2   % CLAY = 0.7

D85= 3.42 D60= 1.065 D50= 0.718
D30= 0.2858 D15= 0.10375 D10= 0.06934
Cc = 1.1054 Cu = 15.3638

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	13.7	82.8	3.3	0.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			4.42	1.33	0.902	0.468	0.248	0.191	0.86	7.0

MATERIAL DESCRIPTION	USCS	AASHTO
● Zinfandel 635 Cleanout Fabric 04.09.01		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Airport

Date: 05.23.2001

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA   Test No.: 10

Date: 05.23.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Airport
Sample Description: Zinfandel 635 Cleanout Fabric 04.09.01
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	138.66
Tare =	0.00
Dry sample weight =	138.66

Sample split on number 10 sieve
Split sample data:
Sample and tare = 95.07 Tare = 0 Sample weight = 95.07
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.5 inches	0.00	100.0
0.375 inches	4.36	96.9
# 4	19.06	86.3
# 8	38.67	72.1
# 10	43.59	68.6
# 16	16.07	57.0
# 20	28.06	48.3
# 30	42.82	37.7
# 40	57.29	27.2
# 50	68.66	19.0
# 100	85.77	6.7
# 200	90.26	3.5

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 3.5
Weight of hydrometer sample: 95.07
Calculated biased weight= % 2740.62498961
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.56
Specific gravity correction factor= 1.022
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

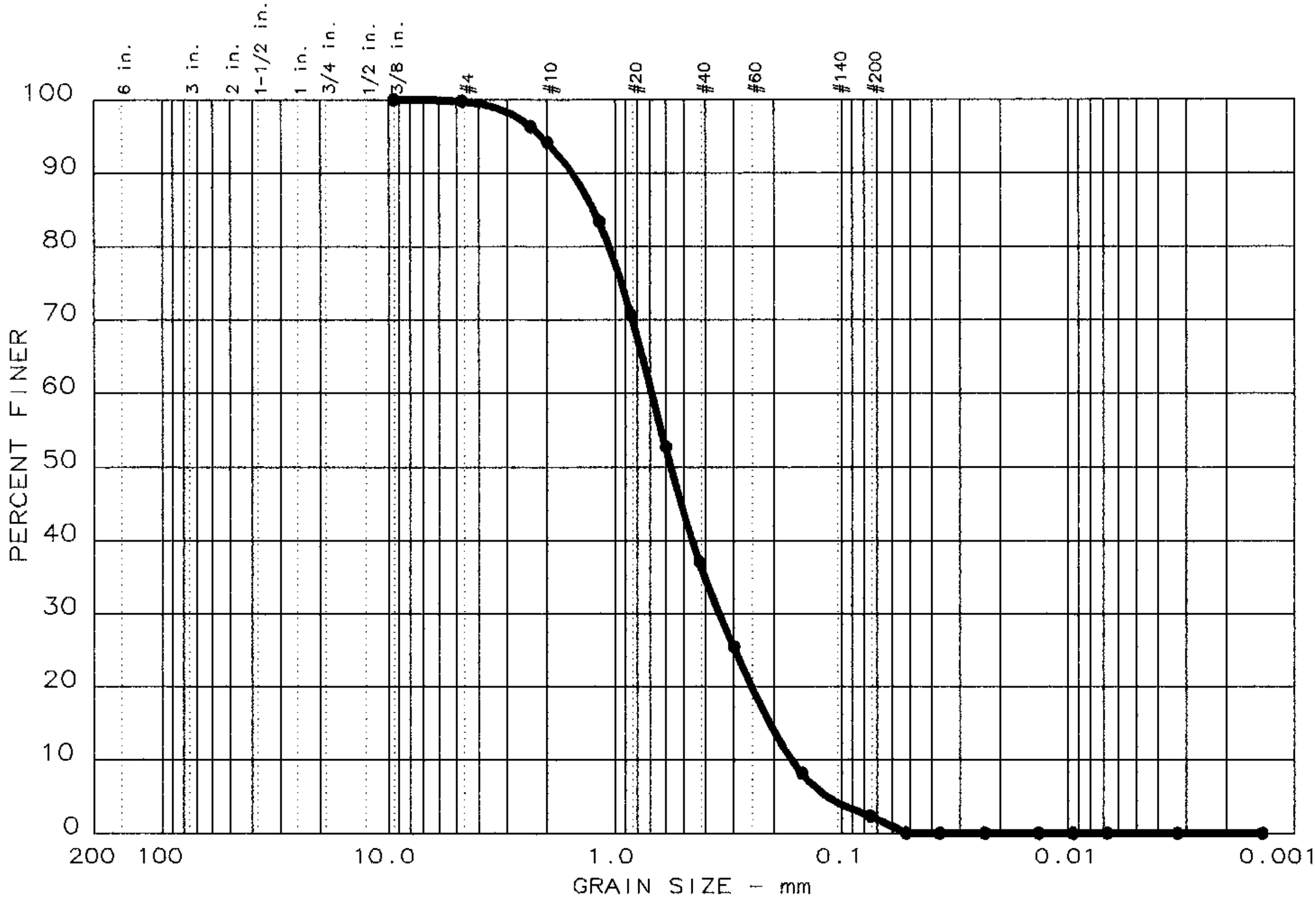
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	22.0	11.0	6.4	0.0137	10.0	14.7	0.0524	0.2
2.0	22.0	10.0	5.4	0.0137	9.0	14.8	0.0373	0.2
5.0	22.0	10.0	5.4	0.0137	9.0	14.8	0.0236	0.2
15.0	22.0	9.5	4.9	0.0137	8.5	14.9	0.0136	0.2
30.0	22.0	9.0	4.4	0.0137	8.0	15.0	0.0097	0.2
60.0	22.0	8.0	3.4	0.0137	7.0	15.1	0.0069	0.1
250.0	22.0	8.0	3.4	0.0137	7.0	15.1	0.0034	0.1
1440.0	21.1	8.0	3.2	0.0138	7.0	15.1	0.0014	0.1

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 13.7 % SAND = 82.8
% SILT = 3.3 % CLAY = 0.2

D85= 4.42 D60= 1.334 D50= 0.902
D30= 0.4677 D15= 0.24831 D10= 0.19055
Cc = 0.8610 Cu = 6.9984

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.2	97.5	2.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.24	0.689	0.566	0.345	0.207	0.165	1.05	4.2

MATERIAL DESCRIPTION	USCS	AASHTO
● HWY 89 Upgradient Can 4.1~~2~~.2001 04		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.07.2001

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA   Test No.: 20

Date: 06.07.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: HWY 89 Upgradient Can 4.12.2001
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 125.74
Tare = 0.00
Dry sample weight = 125.74
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	0.24	99.8
# 8	4.64	96.3
# 10	7.28	94.2
# 16	20.83	83.4
# 20	36.91	70.6
# 30	59.41	52.8
# 40	79.05	37.1
# 50	93.68	25.5
# 100	115.43	8.2
# 200	122.78	2.4

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 2.4
Weight of hydrometer sample: 118.46
Calculated biased weight= % 5032.14878378
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1

Specific gravity of solids= 2.642
Specific gravity correction factor= 1.002
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

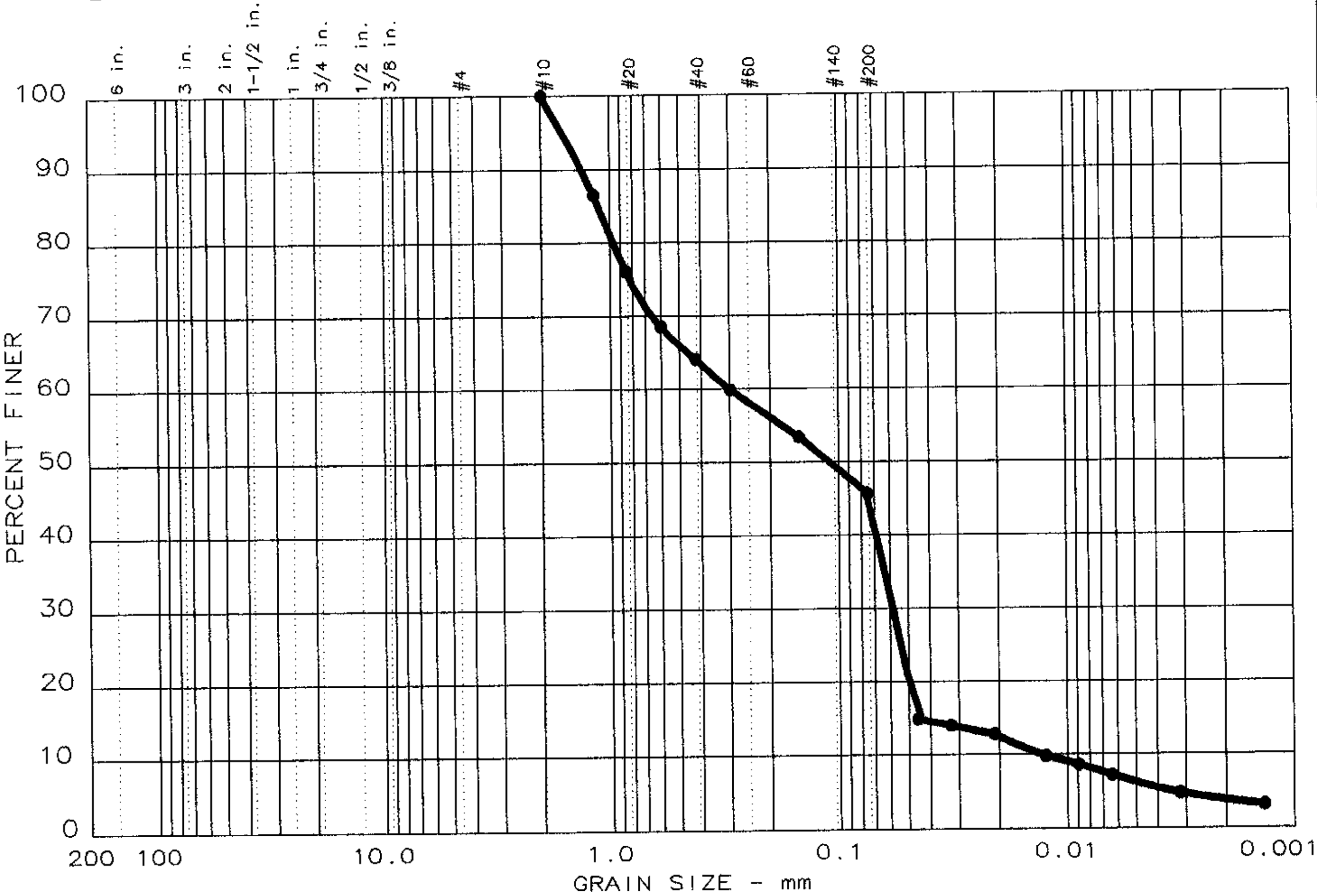
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.8	7.5	2.9	0.0134	6.5	15.2	0.0522	0.1
2.0	21.8	7.0	2.4	0.0134	6.0	15.3	0.0370	0.0
5.0	21.8	7.0	2.4	0.0134	6.0	15.3	0.0234	0.0
15.0	21.8	7.0	2.4	0.0134	6.0	15.3	0.0135	0.0
30.0	21.8	7.0	2.4	0.0134	6.0	15.3	0.0096	0.0
60.0	21.8	7.0	2.4	0.0134	6.0	15.3	0.0068	0.0
250.0	22.1	6.5	1.9	0.0133	5.5	15.4	0.0033	0.0
1440.0	21.2	6.5	1.7	0.0135	5.5	15.4	0.0014	0.0

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 0.2   % SAND = 97.5
% FINES = 2.3

D85= 1.24 D60= 0.689 D50= 0.566
D30= 0.3451 D15= 0.20725 D10= 0.16463
Cc = 1.0508 Cu = 4.1831

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	54.4	39.4	6.2

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.12	0.299	0.110	0.0582	0.0457	0.0129	0.88	23.2

MATERIAL DESCRIPTION	USCS	AASHTO
● HWY 89 Downgradient Can 4.~~12~~ 04.2001		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.07.2001

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	21.4	29.5	24.8	0.0134	28.5	11.6	0.0457	15.0
2.0	21.4	28.0	23.3	0.0134	27.0	11.9	0.0327	14.1
5.0	21.4	26.0	21.3	0.0134	25.0	12.2	0.0210	12.9
15.0	21.4	21.0	16.3	0.0134	20.0	13.0	0.0125	9.8
30.0	21.4	19.0	14.3	0.0134	18.0	13.3	0.0089	8.6
60.0	21.9	16.5	11.9	0.0133	15.5	13.8	0.0064	7.2
250.0	22.0	12.5	7.9	0.0133	11.5	14.4	0.0032	4.8
1440.0	21.3	10.0	5.2	0.0134	9.0	14.8	0.0014	3.2

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 54.4
% SILT = 39.4 % CLAY = 6.2

D85= 1.12 D60= 0.299 D50= 0.110
D30= 0.0582 D15= 0.04571 D10= 0.01288
Cc = 0.8810 Cu = 23.1739

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 19

Date: 06.07.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: HWY 89 Downgradient Can 4.12.2001
USCS Class:
Liquid limit:
AASHTO Class:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 75.50
Tare = 0.00
Dry sample weight = 75.50
Tare for cumulative weight retained= 0

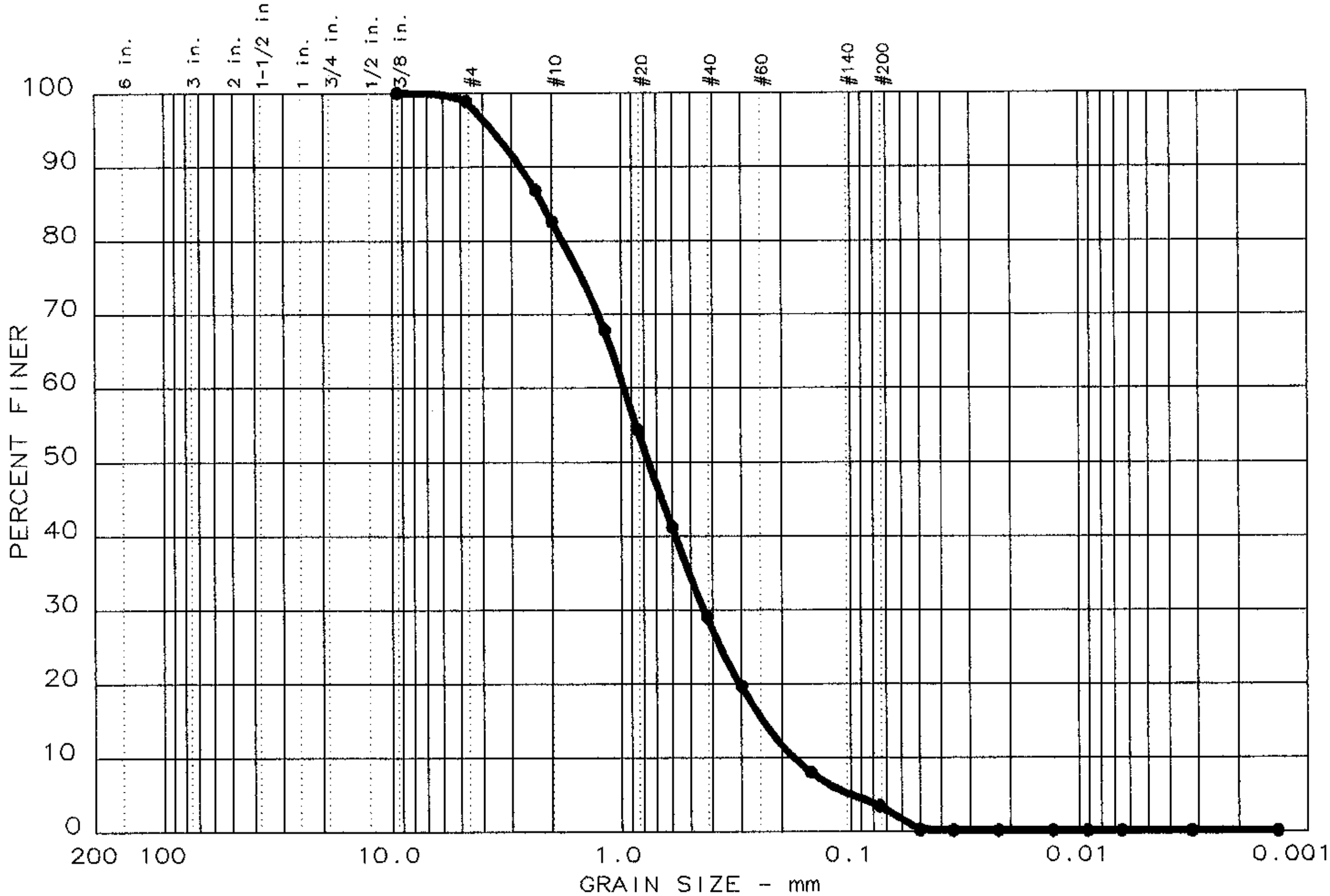
Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 16	10.17	86.5
# 20	18.08	76.1
# 30	23.72	68.6
# 40	27.06	64.2
# 50	30.26	59.9
# 100	35.16	53.4
# 200	41.04	45.6

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 45.6
Weight of hydrometer sample: 75.5
Calculated biased weight= 165.42
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.649
Specific gravity correction factor= 1.000
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	1.1	95.4	3.4	0.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			2.19	0.972	0.761	0.437	0.240	0.176	1.12	5.5

MATERIAL DESCRIPTION	USCS	AASHTO
● Echo Upgradient Can 050201		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.21.2001

Remarks:

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 15

Date: 06.21.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Echo Upgradient Can 050201
USCS Class:
Liquid limit:
AASHTO Class:
Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

	Initial
Dry sample and tare=	112.48
Tare =	0.00
Dry sample weight =	112.48

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	1.23	98.9
# 8	14.83	86.8
# 10	19.58	82.6
# 16	36.18	67.8
# 20	51.36	54.3
# 30	66.11	41.2
# 40	79.77	29.1
# 50	90.35	19.7
# 100	103.37	8.1
# 200	108.55	3.5

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 3.5
Weight of hydrometer sample: 92.9
Calculated biased weight= % 2658.8783715
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1

Specific gravity of solids= 2.658
Specific gravity correction factor= 0.998
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

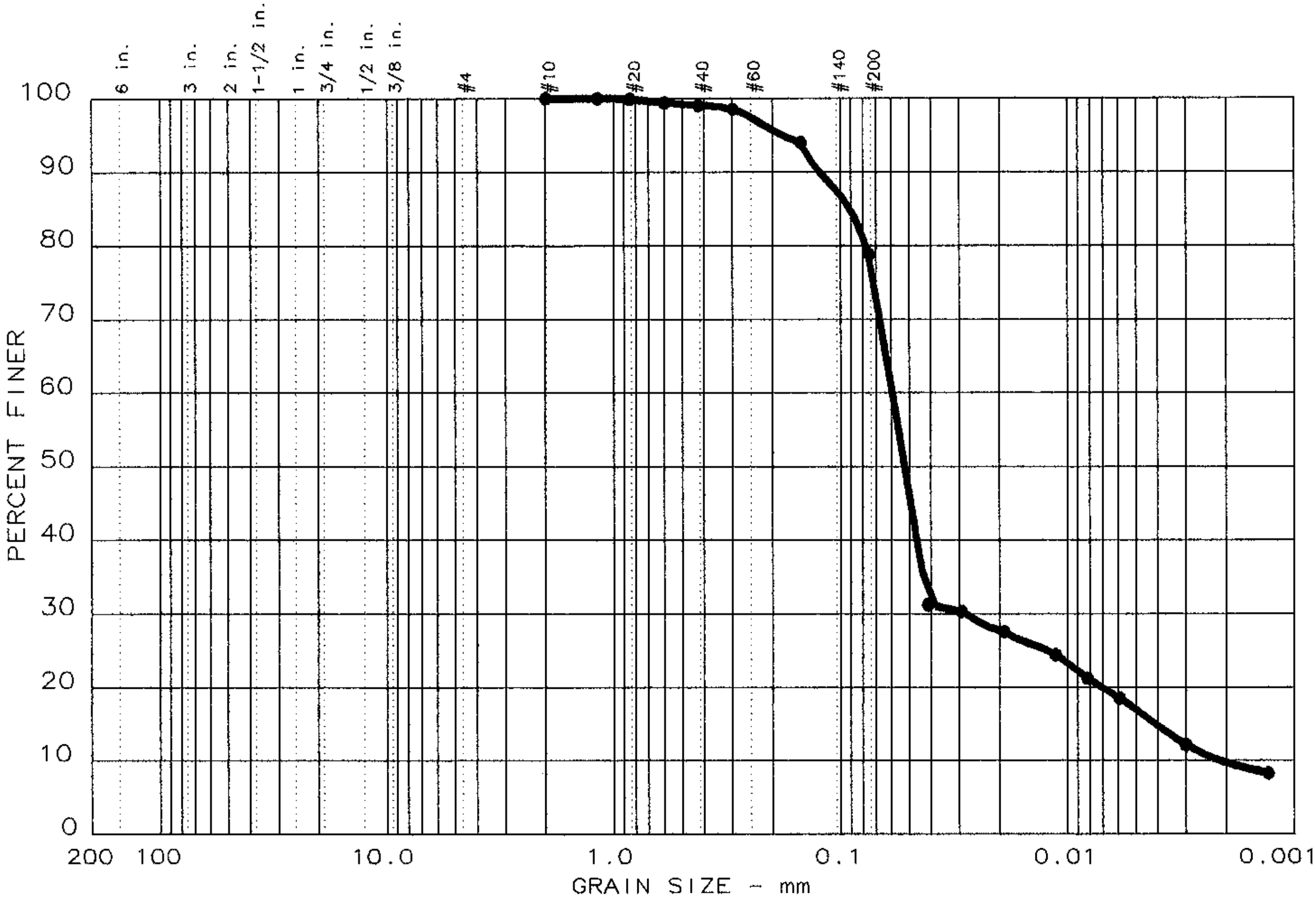
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	24.0	10.0	6.0	0.0130	9.0	14.8	0.0499	0.2
2.0	24.0	8.0	4.0	0.0130	7.0	15.1	0.0357	0.1
5.0	24.0	7.5	3.5	0.0130	6.5	15.2	0.0226	0.1
15.0	24.0	7.5	3.5	0.0130	6.5	15.2	0.0131	0.1
30.0	24.0	7.5	3.5	0.0130	6.5	15.2	0.0092	0.1
60.0	24.0	7.0	3.0	0.0130	6.0	15.3	0.0065	0.1
250.0	24.0	6.5	2.5	0.0130	5.5	15.4	0.0032	0.1
1440.0	23.0	6.5	2.2	0.0131	5.5	15.4	0.0014	0.1

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0   % GRAVEL = 1.1   % SAND = 95.4
% SILT = 3.4   % CLAY = 0.1

D85= 2.19 D60= 0.972 D50= 0.761
D30= 0.4370 D15= 0.24016 D10= 0.17599
Cc = 1.1169 Cu = 5.5208

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	21.2	61.8	17.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.0902		0.0522	0.0280	0.0041	0.0021	6.31	28.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Echo Downgradient Can 050201		

Project No.: 65880.01
Project: CDM
● Location: Tahoe Basin

Date: 06.21.2001

GRAIN SIZE DISTRIBUTION TEST REPORT
GOODSON & ASSOCIATES, INC.
Consulting Engineers

Remarks:

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST DATA   Test No.: 15

Date: 06.21.2001
Project No.: 65880.01
Project: CDM

Sample Data

Location of Sample: Tahoe Basin
Sample Description: Echo Downgradient Can 050201
USCS Class: Liquid limit:
AASHTO Class: Plasticity index:

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
Dry sample and tare= 86.78
Tare = 0.00
Dry sample weight = 86.78
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 16	0.03	100.0
# 20	0.13	99.9
# 30	0.54	99.4
# 40	0.86	99.0
# 50	1.30	98.5
# 100	5.22	94.0
# 200	18.40	78.8

Hydrometer Analysis Data

Separation sieve is number 200
Percent -#200 based on complete sample= 78.8
Weight of hydrometer sample: 86.78
Calculated biased weight= 110.13
Automatic temperature correction
Composite correction at 20 deg C =-5

Meniscus correction only=-1
Specific gravity of solids= 2.654
Specific gravity correction factor= 0.999
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.0	24.0	38.5	34.5	0.0130	37.5	10.1	0.0413	31.3
2.0	24.0	37.5	33.5	0.0130	36.5	10.3	0.0295	30.3
5.0	24.0	34.5	30.5	0.0130	33.5	10.8	0.0191	27.6
15.0	24.0	31.0	27.0	0.0130	30.0	11.4	0.0113	24.4
30.0	24.0	27.5	23.5	0.0130	26.5	11.9	0.0082	21.3
60.0	24.0	24.5	20.5	0.0130	23.5	12.4	0.0059	18.6
250.0	24.0	17.5	13.5	0.0130	16.5	13.6	0.0030	12.2
1440.0	23.0	13.5	9.2	0.0131	12.5	14.2	0.0013	8.3

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 21.2
% SILT = 61.8 % CLAY = 17.0

D85= 0.09 D60= 0.059 D50= 0.052
D30= 0.0280 D15= 0.00405 D10= 0.00210
Cc = 6.3096 Cu = 28.1838

Appendix D-2
Grain Size Analysis
Particle Count Results

WATER MANAGEMENT LABORATORIES INC.

1515 80th St. E.
Tacoma, WA 98404
(253) 531-3121

June 4, 2001

Camp Dresser & McKee, Inc.
PO Box 1158
Gig Harbor, WA 98335
Attn: Rick Shambro, Denver Office

Dear Sir:

Results of analysis of eight storm-drain sediment samples received 05-18-01 at 9:45 a.m. are as follows:

Project: Calstans/LakeTahoe

Sample Identification: TFF – 040601, 4-6-01

Test	**Result**
Particle Count (per gram)	93,600,000

5% particles 5 millimeters
0% particles 9 - 12 microns
1% particles 6 - microns
7% particles 3 - 6 microns
87% particles less than 3 microns

Sample Identification: ZFF – 032701, 3-27-01

Test	**Result**
Particle Count (per gram)	44,200,000

18% particles 10 - 30 millimeters
0% particles 9 - 12 microns
1% particles 6 - 9 microns
2% particles 4 - 6 microns
37% particles 3 microns
42% particles less than 2 microns

Sample Identification: TFF – 032001, 3-20-01

Test	**Result**
Particle Count (per gram)	260,000,000

1% particles 5 - 9 millimeters
0% particles 9 - 12 microns
1% particles 6 - 9 microns
0% particles 4 - 6 microns
9% particles 3 microns
91% particles less than 2 microns

Sample Identification: EFF – 032~~7~~01, 3-~~27~~-01
5 25

Test	**Result**
Particle Count (per gram)	251,000,000

4% particles 7 - 10 millimeters
0% particles 9 - 12 microns
0% particles 6 - 9 microns
3% particles 3 - 6 microns
93% particles 1 - 3 microns

Sample Identification: EM1 – 031401, 3-14-01

Test	**Result**
Particle Count (per gram)	382,000,000

2% particles 1 - 4 millimeters
0% particles 9 - 12 microns
1% particles 6 - 9 microns
2% particles 3 - 6 microns
10% particles 1- 2 microns
85 ~~95~~% particles less than 1 micron
TB

Sample Identification: EM2 – 031401, 3-14-01

Test	**Result**
Particle Count (per gram)	134,000,000

5% particles 5 millimeters
0% particles 9 - 12 microns
0% particles 6 - 9 microns
0% particles 3 - 6 microns
95% particles less than 3 microns

Sample Identification: EA1 – 031401, 3-14-01

Test	**Result**
Particle Count (per gram)	47,000,000

7% particles 2 - 5 millimeters
1% particles 9 - 12 microns
1% particles 6 - 9 microns
1% particles 3 - 6 microns
90% particles less than 2 microns

Sample Identification: EA2 – 031401, 3-14-01

Test	**Result**
Particle Count (per gram)	30,000,000

5% particles 1 - 3 millimeters
0% particles 9 - 12 microns
0% particles 6 - 9 microns
1% particles 4 - 6 microns
5% particles 3 microns
89% particles less than 2 microns

Lab Numbers: 08936716 through 08936723

Samples were analyzed according to Standard Methods for the Examination of Water and Wastewater, 19th Edition.

Chain of Custody record is enclosed.

Sincerely,

Diane DuMond

Diane DuMond
Microbiologist

DD:jat
enclosure

R:\COMM\CAMPDRESSER&MCKEE5-18

CHAIN OF CUSTODY RECORD

Camp Dresser & McKee Inc. Denver

F6260
CDM

PROJECT NAME Caltrans Tahoe

PROJECT NUMBER ______

Field Log Book Reference No. ______

SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	ANALYSES: EXTR. ORG.	VOA	PEST./PCB	TRACE METALS	WPA TEST	NUMBER OF CONTAINERS	LOG BOOK PG. NO.	REMARKS
TFF-040601	4/6/01		036716									Questions
ZFF-032701	3/27/01		036717									Call Todd Burgesser
TFF-032001	3/20/01		036718									303298-1311
EFF-032701	3/27/01		036719									
Em1-031401	3/14/01		036720									
Em2-031401			036721									
EA1-031401			036722									
EA2-031401			036723									

SAMPLED BY (SIGN) JB

RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)	RELINQUISHED BY (SIGN)
① JB	②		④	⑤
DATE/TIME (5/16/01 / 1500)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)
RECEIVED BY (SIGN)	RECEIVED BY (SIGN)	RECEIVED BY (SIGN)	RECEIVED BY (SIGN)	RECEIVED BY (SIGN)
① Deane DuMa[illegible]	②	③	④	⑤
DATE/TIME (5-18-01 / 9:45AM)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)	DATE/TIME (/)

METHOD OF SHIPMENT	SHIPPED BY (SIGN)	RECEIVED FOR LABORATORY BY (SIGN)	DATE/TIME
Fed X	JB		(/)

LEGEND: Original: Return to Sample Traffic Control Center Copies: Ship with Samples

Appendix E
Sediment Quality Analytical Results

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Total Organic Carbon	11000		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Total Organic Carbon	14000		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Total Organic Carbon	13000		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Total Organic Carbon	11000		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Total Organic Carbon	8500		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Total Kjeldahl Nitrogen	770		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Total Kjeldahl Nitrogen	760		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Total Kjeldahl Nitrogen	820		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Total Kjeldahl Nitrogen	830		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Total Kjeldahl Nitrogen	710		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Nitrate+Nitrite	0.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Nitrate+Nitrite	1	U	mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Nitrate+Nitrite	1	U	mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Nitrate+Nitrite	1	U	mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Nitrate+Nitrite	2.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Nitrite	0.36		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Nitrite	0.5		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Nitrite	0.9		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Nitrite	0.49		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Nitrite	0.41		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Phosphorus	3.5		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Phosphorus	2.4		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Phosphorus	2.3		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Phosphorus	0.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Phosphorus	0.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Cadmium	2.13		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Cadmium	2.69		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Cadmium	2.57		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Cadmium	2.15		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Cadmium	2.66		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Chromium	33.3		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Chromium	40.5		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Chromium	39		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Chromium	33.3		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Chromium	41.9		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Copper	46.1		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Copper	55.3		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Copper	53.2		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Copper	48.6		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Copper	287		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Lead	48.6		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Lead	54.1		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Lead	55		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Lead	51.7		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Lead	82		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Nickel	21.4		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Nickel	25.6		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Nickel	24		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Nickel	20.4		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Nickel	24.4		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Zinc	385		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Zinc	422		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Zinc	418		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Zinc	373		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Zinc	378		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>10	Iron	17300		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>20-10	Iron	22000		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>50-20	Iron	21200		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	>635-50	Iron	18600		mg/kg
Echo Summit	Filter Box (Effluent)	1/29/01	2/28/01	1	<635	Iron	21400		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Total Organic Carbon	1900		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Total Organic Carbon	2700		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Total Organic Carbon	1900		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Total Organic Carbon	770		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Total Organic Carbon	4500		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Total Kjeldahl Nitrogen	550		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Total Kjeldahl Nitrogen	570		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Total Kjeldahl Nitrogen	420		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Total Kjeldahl Nitrogen	390		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Total Kjeldahl Nitrogen	310		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Nitrate+Nitrite	0.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Nitrate+Nitrite	0.5	U	mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Nitrate+Nitrite	1	U	mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Nitrite	0.08		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Nitrite	0.14		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Nitrite	0.09		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Nitrite	0.09		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Nitrite	1.9		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Phosphorus	4.7		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Phosphorus	3.1		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Phosphorus	3.2		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Phosphorus	4		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Phosphorus	0.5	U	mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Cadmium	1.64		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Cadmium	1.28		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Cadmium	1.69		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Cadmium	1.13		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Cadmium	2.06		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Chromium	26.5		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Chromium	21		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Chromium	26.4		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Chromium	18.9		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Chromium	29.4		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Copper	33.4		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Copper	29.3		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Copper	32		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Copper	23		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Copper	97.8		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Lead	33		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Lead	30.7		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Lead	34.9		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Lead	23.5		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Lead	54.2		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Nickel	16.2		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Nickel	13.1		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Nickel	16.1		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Nickel	11.6		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Nickel	18.7		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Zinc	199		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Zinc	197		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Zinc	204		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Zinc	128		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Zinc	287		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>10	Iron	15000		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>20-10	Iron	12300		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>50-20	Iron	14800		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	>635-50	Iron	11600		mg/kg
Echo Summit	Filter Box (Effluent)	2/28/01	3/25/01	1	<635	Iron	15800		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Total Organic Carbon	2100		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Total Organic Carbon	1400		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Total Organic Carbon	970		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Total Organic Carbon	1000		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Total Organic Carbon	1600		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Total Kjeldahl Nitrogen	130		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Total Kjeldahl Nitrogen	350		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Total Kjeldahl Nitrogen	360		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Total Kjeldahl Nitrogen	360		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Total Kjeldahl Nitrogen	170		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Nitrite	0.079		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Nitrite	0.05	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Nitrite	0.062		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Nitrite	0.068		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Nitrite	0.073		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Phosphorus	0.92		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Phosphorus	0.71		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Phosphorus	0.6		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Phosphorus	1.2		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Phosphorus	1.5		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Cadmium	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Cadmium	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Cadmium	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Cadmium	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Cadmium	0.5	U	mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Chromium	5.29		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Chromium	4.06		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Chromium	5.35		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Chromium	11.1		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Chromium	12.9		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Copper	6.13		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Copper	7.78		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Copper	8.54		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Copper	13.5		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Copper	16.7		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Lead	2.7		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Lead	6		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Lead	9.94		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Lead	16		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Lead	19.4		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Nickel	8.03		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Nickel	4.75		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Nickel	5.16		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Nickel	8.91		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Nickel	9.29		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Zinc	22.2		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Zinc	32.8		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Zinc	40.9		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Zinc	63		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Zinc	77.5		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>10	Iron	4860		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>20-10	Iron	5410		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>50-20	Iron	5400		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	>635-50	Iron	9240		mg/kg
Highway 89	Down-gradient Barrel		4/12/01	1	<635	Iron	10000		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Total Organic Carbon	6900		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Total Organic Carbon	9400		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Total Organic Carbon	8500		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Total Organic Carbon	7400		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Total Organic Carbon	5500		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Total Kjeldahl Nitrogen	1400		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Total Kjeldahl Nitrogen	1400		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Total Kjeldahl Nitrogen	880		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Total Kjeldahl Nitrogen	860		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Total Kjeldahl Nitrogen	940		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Nitrate+Nitrite	6.5		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Nitrate+Nitrite	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Nitrite	0.081		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Nitrite	0.05	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Nitrite	4.2		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Nitrite	0.15		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Nitrite	0.081		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Phosphorus	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Phosphorus	2		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Phosphorus	1.5		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Phosphorus	2		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Phosphorus	2.9		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Cadmium	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Cadmium	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Cadmium	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Cadmium	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Cadmium	0.5	U	mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Chromium	10.2		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Chromium	9.98		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Chromium	9.46		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Chromium	11.8		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Chromium	12.1		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Copper	26.7		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Copper	25.9		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Copper	23.8		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Copper	27		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Copper	29.7		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Lead	12.3		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Lead	10.3		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Lead	12.4		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Lead	12		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Lead	13.8		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Nickel	17.3		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Nickel	15.3		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Nickel	14.4		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Nickel	15.9		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Nickel	16.9		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Zinc	133		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Zinc	124		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Zinc	195		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Zinc	150		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Zinc	146		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>10	Iron	16300		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>20-10	Iron	16300		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>50-20	Iron	15500		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	>635-50	Iron	17200		mg/kg
Highway 89	Up-gradient Barrel		4/12/01	1	<635	Iron	18000		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Total Organic Carbon	17000		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Total Organic Carbon	17000		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Total Organic Carbon	16000		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Total Organic Carbon	6600		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Total Organic Carbon	15000		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Total Kjeldahl Nitrogen	800		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Total Kjeldahl Nitrogen	1200		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Total Kjeldahl Nitrogen	1100		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Total Kjeldahl Nitrogen	950		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Total Kjeldahl Nitrogen	970		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Nitrate+Nitrite	0.5	U	mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Nitrite	0.016		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Nitrite	0.17		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Nitrite	0.18		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Nitrite	0.26		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Nitrite	0.57		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Phosphorus	2.1		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Phosphorus	2.3		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Phosphorus	3		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Phosphorus	7.9		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Phosphorus	20		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Cadmium	0.844		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Cadmium	0.965		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Cadmium	1.02		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Cadmium	0.787		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Cadmium	0.877		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Chromium	13.5		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Chromium	17		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Chromium	18.7		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Chromium	15.9		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Chromium	17.1		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Copper	38.4		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Copper	46		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Copper	49.3		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Copper	39.1		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Copper	45		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Lead	21.6		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Lead	24.1		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Lead	24		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Lead	20.4		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Lead	26		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Nickel	15.7		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Nickel	17.2		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Nickel	17.8		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Nickel	15.2		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Nickel	15.5		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Zinc	588		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Zinc	646		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Zinc	633		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Zinc	518		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Zinc	536		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>10	Iron	14900		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>20-10	Iron	19000		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>50-20	Iron	20900		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	>635-50	Iron	17800		mg/kg
Tahoe Airport	Down-gradient Barrel	12/29/00	4/2/01	1	<635	Iron	19100		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Total Organic Carbon	4100		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Total Organic Carbon	3900		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Total Organic Carbon	3400		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Total Organic Carbon	2700		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Total Organic Carbon	5700		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Total Kjeldahl Nitrogen	3200		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Total Kjeldahl Nitrogen	1000		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Total Kjeldahl Nitrogen	1000		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Total Kjeldahl Nitrogen	1100		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Total Kjeldahl Nitrogen	790		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Nitrate+Nitrite	0.5		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Nitrate+Nitrite	0.8		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Nitrate+Nitrite	0.6		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Nitrate+Nitrite	10	U	mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Nitrite	0.29		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Nitrite	0.27		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Nitrite	0.26		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Nitrite	0.44		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Nitrite	0.06		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Phosphorus	4.7		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Phosphorus	2.9		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Phosphorus	6.4		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Phosphorus	15		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Phosphorus	2.1		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Cadmium	2.39		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Cadmium	2.34		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Cadmium	2.19		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Cadmium	2.34		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Cadmium	1.07		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Chromium	16.6		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Chromium	15.9		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Chromium	16.7		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Chromium	16		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Chromium	8.01		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Copper	43.6		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Copper	46.6		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Copper	41.4		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Copper	50.1		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Copper	32.8		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Lead	21.3		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Lead	21.9		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Lead	22.2		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Lead	28.2		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Lead	19.2		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Nickel	16.1		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Nickel	15.7		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Nickel	15.7		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Nickel	16.2		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Nickel	7.67		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Zinc	482		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Zinc	422		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Zinc	408		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Zinc	490		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Zinc	187		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>10	Iron	17000		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>20-10	Iron	16400		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>50-20	Iron	15100		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	>635-50	Iron	16100		mg/kg
Tahoe Airport	Filter Box (Effluent)	12/29/00	2/28/01	1	<635	Iron	8730		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Total Organic Carbon	3700		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Total Organic Carbon	4600		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Total Organic Carbon	4400		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Total Organic Carbon	3500		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Total Organic Carbon	2300		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Total Kjeldahl Nitrogen	510		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Total Kjeldahl Nitrogen	250		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Total Kjeldahl Nitrogen	310		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Total Kjeldahl Nitrogen	340		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Total Kjeldahl Nitrogen	460		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Nitrate+Nitrite	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Nitrite	0.088		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Nitrite	0.05	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Nitrite	0.05	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Nitrite	0.05	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Nitrite	0.099		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Phosphorus	2		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Phosphorus	0.94		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Phosphorus	2.5		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Phosphorus	1.2		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Phosphorus	4.3		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Cadmium	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Cadmium	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Cadmium	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Cadmium	0.5	U	mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Cadmium	0.503		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Chromium	7.28		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Chromium	5.43		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Chromium	7.69		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Chromium	12.8		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Chromium	13.5		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Copper	16.4		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Copper	13.7		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Copper	14.8		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Copper	25.5		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Copper	32.6		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Lead	7.96		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Lead	6.06		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Lead	7.56		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Lead	13.7		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Lead	19		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Nickel	7.23		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Nickel	6.79		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Nickel	7.25		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Nickel	10.7		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Nickel	11.5		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Zinc	162		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Zinc	90.5		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Zinc	104		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Zinc	175		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Zinc	210		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>10	Iron	8480		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>20-10	Iron	7770		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>50-20	Iron	8580		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	>635-50	Iron	14300		mg/kg
Tahoe Airport	Up-gradient Barrel	12/29/00	4/2/01	1	<635	Iron	15600		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Total Organic Carbon	3500		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Total Organic Carbon	1700		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Total Organic Carbon	2000		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Total Organic Carbon	1900		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Total Organic Carbon	15000		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Total Kjeldahl Nitrogen	810		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Total Kjeldahl Nitrogen	1700		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Total Kjeldahl Nitrogen	3000		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Total Kjeldahl Nitrogen	2300		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Total Kjeldahl Nitrogen	2400		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Nitrate+Nitrite	0.5	U	mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Nitrite	0.05	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Nitrite	0.06		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Nitrite	0.05	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Nitrite	0.05	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Nitrite	0.27		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Phosphorus	6.7		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Phosphorus	16		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Phosphorus	7.6		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Phosphorus	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Phosphorus	5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Cadmium	1.25		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Cadmium	2.16		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Cadmium	2.1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Cadmium	3.63		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Cadmium	4.72		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Chromium	20.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Chromium	26.3		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Chromium	28.4		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Chromium	40.3		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Chromium	56.2		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Copper	22.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Copper	45.3		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Copper	72.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Copper	93.1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Copper	169		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Lead	7.99		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Lead	26.4		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Lead	46.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Lead	83.9		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Lead	87.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Nickel	34.9		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Nickel	23.9		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Nickel	24		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Nickel	33.5		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Nickel	46.5		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Zinc	70.1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Zinc	434		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Zinc	315		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Zinc	506		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Zinc	658		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>10	Iron	6750		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>20-10	Iron	15500		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>50-20	Iron	10700		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	>635-50	Iron	16200		mg/kg
Zinfandel	Filter Box (Direct Runoff)	3/22/01	3/27/01	2	<635	Iron	22100		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Total Organic Carbon	6600		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Total Organic Carbon	6800		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Total Organic Carbon	7300		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Total Organic Carbon	8000		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Total Organic Carbon	14000		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Total Kjeldahl Nitrogen	960		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Total Kjeldahl Nitrogen	2200		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Total Kjeldahl Nitrogen	2000		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Total Kjeldahl Nitrogen	1900		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Total Kjeldahl Nitrogen	280		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Nitrite	0.05	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Nitrite	1.3		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Nitrite	1.5		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Nitrite	1.7		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Nitrite	0.05	U	mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Phosphorus	1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Phosphorus	7.4		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Phosphorus	1.2		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Phosphorus	1.7		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Phosphorus	12		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Cadmium	0.513		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Cadmium	0.574		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Cadmium	0.786		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Cadmium	1.78		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Cadmium	1.66		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Chromium	10.1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Chromium	39.2		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Chromium	35.4		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Chromium	40.3		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Chromium	43.1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Copper	24		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Copper	53.4		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Copper	53.7		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Copper	88.2		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Copper	92.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Lead	9.96		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Lead	16.5		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Lead	23.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Lead	51.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Lead	63.2		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Nickel	11.1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Nickel	24.1		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Nickel	29.8		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Nickel	33.7		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Nickel	36.5		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Zinc	53.6		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Zinc	368		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Zinc	184		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Zinc	324		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Zinc	357		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>10	Iron	9140		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>20-10	Iron	12900		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>50-20	Iron	12700		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	>635-50	Iron	15700		mg/kg
Zinfandel	Filter Box (Direct Runoff)	4/4/01	4/9/01	3	<635	Iron	17400		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Zinfandel	Pipe Deposits		4/9/01	3	>10	Total Organic Carbon	820		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Total Organic Carbon	2100		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Total Organic Carbon	1800		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Total Organic Carbon	2100		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Total Organic Carbon	1700		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Total Kjeldahl Nitrogen	160		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Total Kjeldahl Nitrogen	250		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Total Kjeldahl Nitrogen	20	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Total Kjeldahl Nitrogen	80		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Total Kjeldahl Nitrogen	180		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Nitrate+Nitrite	0.5	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Nitrite	0.05	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Nitrite	0.05	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Nitrite	0.061		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Nitrite	0.05	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Nitrite	0.05	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Phosphorus	1		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Phosphorus	2.2		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Phosphorus	2		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Phosphorus	1.6		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Phosphorus	2.9		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Cadmium	0.5	U	mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Cadmium	2.15		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Cadmium	0.644		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Cadmium	0.0666		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Cadmium	3.93		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Chromium	11.7		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Chromium	16.4		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Chromium	32.8		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Chromium	29.5		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Chromium	27.2		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Copper	11.2		mg/kg

Site	Location	Installation	Collection	Period	Size Fraction	Parameter	Value	Qualifier	Units
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Copper	624		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Copper	63.7		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Copper	230		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Copper	81.5		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Lead	4.11		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Lead	41.8		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Lead	42.8		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Lead	16.9		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Lead	45.6		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Nickel	23.3		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Nickel	15.8		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Nickel	35.7		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Nickel	21.9		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Nickel	25.2		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Zinc	25.9		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Zinc	4490		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Zinc	185		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Zinc	178		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Zinc	181		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>10	Iron	4710		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>20-10	Iron	13800		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>50-20	Iron	15000		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	>635-50	Iron	14900		mg/kg
Zinfandel	Pipe Deposits		4/9/01	3	<635	Iron	12200		mg/kg

Appendix F
Data Quality Review

Appendix F
Data Quality

F.1 Overview

This appendix summarizes the quality assurance/quality control (QA/QC) procedures that were implemented in the laboratory to ensure that the data collected in the 2000-2001 monitoring season were of known quality and met the project objectives. A general description of the laboratory QA/QC procedures is discussed in Section F.2. Upon receipt from the laboratory, a complete data quality evaluation was performed on all data generated during this program to ensure that the reported data accurately represent the concentrations of constituents present in the stormwater and in the precipitation samples. The process and results of the data quality evaluation are discussed in Section F.3. Based on the results of the data evaluation, a summary of water quality data is presented in Section F.4.

F.2 Laboratory Quality Assurance/Quality Control Procedures

Quality assurance is defined as the integrated program designed for assuring reliability of monitoring and measurement of data. Quality control is defined as the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measuring process. This section presents quality control procedures that were conducted by the laboratory to ensure analytical data quality. A description of the general practices required of the laboratory is summarized below.

F.2.1 Standard Operating Procedures (SOPs)

Calscience Environmental Laboratories, Inc. (Calscience) performed all analyses and QA/QC procedures in accordance with internal SOPs. These SOPs provide step-by-step instructions for performing analytical methods. Utilizing SOPs is a method to ensure uniformity and compliance in the measurement process.

F.2.2 Purity of Standards, Solvents and Reagents

The purity/quality of reagents, solvents and standards used in the analytical process is a critical component in the generation of high quality data. All reagents used were of reagent-grade (equivalent) or higher grade quality whenever obtainable. Organic solvents were pesticide-grade or equivalent. Where applicable, reference standard solutions were traceable to the National Institute of Standards Technology (NIST), the American Association for Laboratory Accreditation (AALA), or to an equivalent source. Each new lot of reagent-grade chemicals was tested for quality of performance, and laboratory records were kept to document the results of lot tests.

F.2.3 Calibration

Instrument calibration is performed to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for target compounds.

Calibration procedures vary by analytical method. In general, each instrument is calibrated initially using certified standards, followed by periodic (i.e., daily) calibration verifications to confirm that the initial calibration is valid.

F.2.4 Method Blank

A method blank (MB) is a QC sample that consists of all reagents specific to the method and is carried through every aspect of the procedure, including preparation, cleanup and analysis. The MB is used to identify any interferences or contamination of the analytical system that may lead to the reporting of elevated analyte concentrations or false positive data. Potential sources of contamination include solvent, reagents, glassware, or the laboratory environment. The MB is prepared with each group of samples processed. One batch of samples is generally defined as a group of 20 samples or less of the same sample matrix that are processed using the same procedures, reagents and standards within the same time period.

F.2.5 Equipment Blanks

Equipment blanks were prepared to assess potential contamination from autosampler bottles and autosampler pump tubing. To evaluate potential contamination from equipment, equipment blanks were analyzed at the beginning of the season and then several times throughout the season. Equipment blanks were collected by pouring ultrapure water through all the equipment used in the sampling process. The rinsate was then analyzed for metals. Bottle blanks were also collected and analyzed several times throughout the season to assess the impact, if any, of using plastic bottles for the collection of organic analytes. Because sample bottles used in this monitoring program are reused, bottle blank analyses were also performed to determine the effectiveness of the bottle cleaning process performed by the laboratory.

F.2.6 Laboratory Control Sample

A laboratory control sample (LCS) is a laboratory-generated clean matrix sample that is fortified with known concentrations of target analytes. The LCS is then carried along with the environmental samples through the entire sample preparation/analysis sequence. Review of the LCS recovery data is used to monitor the performance of the analytical methods. The results of the LCS, used in conjunction with the matrix spike samples can provide evidence that the laboratory performed the method correctly or the sample matrix affected the results.

F.2.7 Matrix Spike Sample

Matrix spikes (MS) and matrix spike duplicates (MSDs) are analyzed to evaluate the effect of the sample matrix on the accuracy of the analytical procedures. An MS/MSD is an environmental sample to which known concentrations of target analytes have been added. The spiked sample is then carried through the entire analytical sequence. The anlayte concentrations detected during the analysis are compared to the known spike concentrations to obtain a percent recovery for each spiked analyte. The recoveries are compared to acceptance limits and the results are used to evaluate accuracy and the presence of matrix interferences.

The difference between the MS and the MSD analyses is expressed as the relative percent difference (RPD). RPDs are used to evaluate analytical precision and can also be a measure of relative sample heterogeneity.

F.3 Data Quality Evaluation

Upon receipt from the laboratory, each analytical report was thoroughly reviewed and the data evaluated to determine if the data met the project objectives. Initially, the data were screened for the following major items:

- A 100 percent check between electronic data provided by the laboratory and the hard copy reports;
- Conformity check between the chain-of-custody forms, compositing protocol, and laboratory reports;
- A check for laboratory data report completeness; and,
- A check for typographical errors on the laboratory reports.

After performing the aforementioned data screening, the laboratory was notified of any deficiencies by way of a telephone call or through a memorandum detailing the problems encountered during the initial screening process.

Following the initial screening, a more complete QA/QC review process was performed which included an evaluation of method holding times, method and equipment blank contamination, and accuracy and precision. Accuracy was evaluated by reviewing MS, MSD and LCS recoveries; precision was evaluated by reviewing spike duplicate and laboratory sample duplicate RPDs. In addition to manually reviewing the data for the QC elements listed above, all electronic data were checked for compliance with Caltrans-specified accuracy, precision, holding time and reporting limit criteria using Caltrans' Electronic Data Deliverable (EDD) Checker and Automated Data Validation program (August 2000). Data collected during the 2000-2001 monitoring season were the first set of data where the data checker and validation programs were used.

The following sections describe specific items that were evaluated during the QA/QC review process and data that were qualified as estimated due to laboratory QC exceedances.

F.3.1 Holding Times

A sample holding time is defined as the maximum allowable time a sample can be stored after sample collection and preservation until analysis. For composite samples, the time of the last discrete sample is considered the sample collection time for determining the sample holding time. During the data review process, it was determined that, with the exception of nitrate, ortho-phosphate, turbidity and pH, all other analyses were performed within their technical holding times.

Although the samples were analyzed immediately after laboratory receipt and compositing activities, 15 of the 29 samples submitted for analysis for nitrates, and 10 of the 25 samples submitted for dissolved ortho-phosphate, were analyzed beyond the maximum allowable holding time of 48 hours. Therefore, these samples were qualified with a "J" or a "UJ", in accordance with Caltrans protocols, to indicate an estimated or an estimated reporting limit as a result of a holding time exceedance.

Although a numerical holding time is not specified for pH or turbidity, the methods suggest that samples be analyzed for pH and turbidity as soon as possible after sample collection. In accordance with the Caltrans EDD Checker, all samples measured for pH and turbidity after 48 hours from the end of sample collection were flagged with "Js" to indicate estimated results. Although samples were analyzed at the laboratory for pH and turbidity as soon as possible after sample compositing procedures were complete, 12 of the 28 samples submitted for pH and 10 of the 21 samples submitted for turbidity were analyzed after 48 hours had elapsed. Therefore, these samples were qualified with "Js."

F.3.2 Blank Evaluation

As mentioned previously, analytical results from both laboratory method blanks and field equipment blanks were evaluated during the QA/QC review process. Blanks can be used to identify the presence and potential source of sample contamination. If no contamination is present in the blanks, then no further action is required. Laboratory method blanks were analyzed with every batch of samples for most analyses. Additionally, two types of field blanks were collected and analyzed periodically throughout the sampling program: blanks were collected from the sampling equipment (i.e., the pump tubing) and from the sample bottles, which were analyzed to evaluate the effectiveness of the bottle cleaning procedures performed by the laboratory. Bottle blanks were also analyzed for organic constituents (TOC and DOC) to assess the impact of using plastic rather than glass sample containers.

In the 2000-2001 dataset, low levels of inorganic constituents, particularly copper and zinc, were sometimes detected in both types of equipment blanks (pump tubing and bottle blanks). Although these blanks indicated contamination, the impact this contamination had on concentrations in the storm water samples was negligible. The metals concentrations detected in the blanks were less than five times the concentrations detected in the project samples. Therefore, qualification of the data was not warranted. Furthermore, organic constituents (i.e., TOC and DOC) were not detected at concentrations above the laboratory reporting limit of 1 mg/L in any of the bottle blanks. Therefore, it was demonstrated that the use of plastic sample collection containers does not interfere with the analysis of TOC and DOC.

F.3.3 Accuracy and Precision

Accuracy is the degree of agreement between a measurement and the true or expected value or between the average of a number of measurements and the true or expected value. Systematic errors affect accuracy. For chemical properties, accuracy is expressed as percent recovery (%R), which is calculated as follows:

$$\%R = [(Cs - C)/S] * 100$$

where:

%R	=	percent recovery
Cs	=	spiked sample concentration
C	=	background sample concentration
S	=	concentration equivalent of spike added

MS, MSD and LCS results were checked to assess the accuracy of the analytical process. MS and MSD results provided an evaluation of accuracy in environmental sample matrices; whereas, LCS results provided a measure of accuracy throughout the entire recovery process.

Precision is an estimate of variability. In other words, precision is an estimate of agreement among individual measurements of the same physical or chemical property, under prescribed similar conditions. Precision can be calculated as the relative percent difference (RPD) as follows:

$$RPD = 2 * [(S - D)/(S + D)] * 100$$

where:

RPD	=	relative percent difference
S	=	concentration measured in original sample
D	=	concentration measured in duplicate sample

Duplicate sample results were checked to assess the variability between samples. Depending on the analytical method, various types of duplicate results were compared to assess precision. For example, some methods require the analysis of an MS and an MSD sample pair, whereas other methods are not as specific. When not specified, the laboratory calculated precision using a sample and a duplicate of the same sample.

Control limits for spike recoveries and RPDs were defined by the project data quality objectives (DQOs) (LWA, August 1997). These are the acceptance limits that are specified in the EDD Checker and are the limits used to evaluate the usability of the project data.

In general, the laboratory performed very well in meeting the control limits defined by the DQOs (see Table C-1 below). The only QC deficiencies noted were related to MS and/or MSD samples analyzed for metals and phosphorus. With respect to phosphorus analyses, three batches of samples had MS and MSD recoveries that were below the acceptance criteria of 80 to 120 percent. A total of six project samples were included in these three batches of samples. Therefore, results from 6 of the 27 samples analyzed for phosphorus were flagged with "Js" to indicate estimated concentrations as a result of MS and MSD QC exceedances. Although the MS and MSD recoveries were slightly outside the acceptable control limits, the corresponding LCS samples were within acceptable limits, which demonstrates slight matrix interferences.

With respect to metals, out-of-range MS and/or MSD recoveries were reported for arsenic, cadmium, chromium, copper, iron, nickel and zinc. Of the 31 samples analyzed for total and dissolved arsenic, two results were qualified with "Js" to indicate estimated concentrations as a result of low MS or MSD recoveries. The low MS and MSD recoveries for arsenic were isolated to just two batches of samples. In both batches, the corresponding LCS sample was within acceptable limits, thereby demonstrating matrix interferences.

Similar to arsenic, low cadmium, chromium and nickel MS and/or MSD recoveries were also noted in two batches of samples, which affected 4 of the 31 samples analyzed for cadmium and chromium, and 5 of the 31 samples analyzed for nickel. Again, the corresponding LCS samples were within acceptable limits in both batches of samples.

During the copper analyses, three batches of samples had MS samples that were recovered at concentrations below the lower acceptance limit of 80 percent. These analytical batches contained six project samples, which were qualified with "Js" to indicate estimated concentrations. In these batches of samples, the LCS recoveries were within acceptable limits.

The most pronounced matrix interferences were reported for the zinc and iron analyses. In seven analytical batches, which affected a total of 18 project samples, zinc recoveries in the MS and/or MSD samples were outside the acceptance criteria of 80 to 120 percent. In five analytical batches, iron recoveries in the MS and/or MSD samples were outside of the acceptance criteria, which affected a total of nine samples. Recoveries for both iron and zinc were above the upper control limit in some batches, while below the lower control limit in other batches. In all cases, however, the corresponding LCS samples were within acceptable limits. Therefore, matrix interferences were demonstrated. Although the zinc and iron results are considered usable for the project purposes, they were qualified with "Js" to indicate estimated concentrations.

Overall, the QC deficiencies reported during the metals and phosphorus analyses were not considered significant enough to reject the data and were used in subsequent statistical analyses.

Table F-1
Accuracy and Precision Control Limits

Analyte	% Recovery (Accuracy)	RPD (Precision)
Metals (total/dissolved)	75 - 125	20
Nitrate (as N)	80 - 120	20
TKN	80 - 120	20
Phosphorus (total/dissolved)	80 - 120	20
Ortho-Phosphate (dissolved)	80 - 120	20
pH	--	20
Hardness (as $CaCO_3$)	80 - 120	20
SC	--	20
Chloride	80 - 120	20
Turbidity	--	20
Oil & Grease	80 - 120	20
TOC/DOC	85 - 115	15
TSS/TDS	80 - 120	20

F.3.4 Evaluation of Hydrologic Coverage and Flow Data

The final data screening procedure included a qualitative evaluation of each station storm event in terms of hydrologic data and sample coverage to ensure the resulting analytical results represented EMCs. As part of this qualitative evaluation, runoff hydrographs (with plotted sample collection times) and rainfall hyetographs were constructed for each station storm (refer to Appendix A). The hydrographs were carefully reviewed to (1) assess the temporal sample coverage for each station storm and (2) identify any spurious flow data.

Throughout each evaluation, an attempt was made to preserve and incorporate as much of the analytical data as possible, while ensuring the integrity of the data set. Station storms were rejected or accepted based solely on this visual qualitative data evaluation. No quantitative evaluation was conducted as part of this data screening procedure.

In order to reject a given station storm, one, or a combination, of the following would be required:

- A sufficient number of samples were not collected during peak flow.
- A significant portion of the flow hydrograph was not sampled.

During this monitoring season, no data were rejected based on this qualitative evaluation.

F.3.5 Data Evaluation Summary

In general, the QA/QC review of analytical results found all the data to be of acceptable quality and usable for the intended purposes, including sample data qualified as estimated due to slight laboratory QC deficiencies or holding time exceedances. None of the data were rejected for use on the basis of laboratory method deficiencies. Results of this evaluation indicated that all the data were considered acceptable and were used in final data analyses. The evaluation of the hydrologic coverage and flow data provided an assessment of the representativeness of sampling event. Based on the evaluation of hydrologic coverage, all data used in the final data analysis were considered representative of the sampling event.